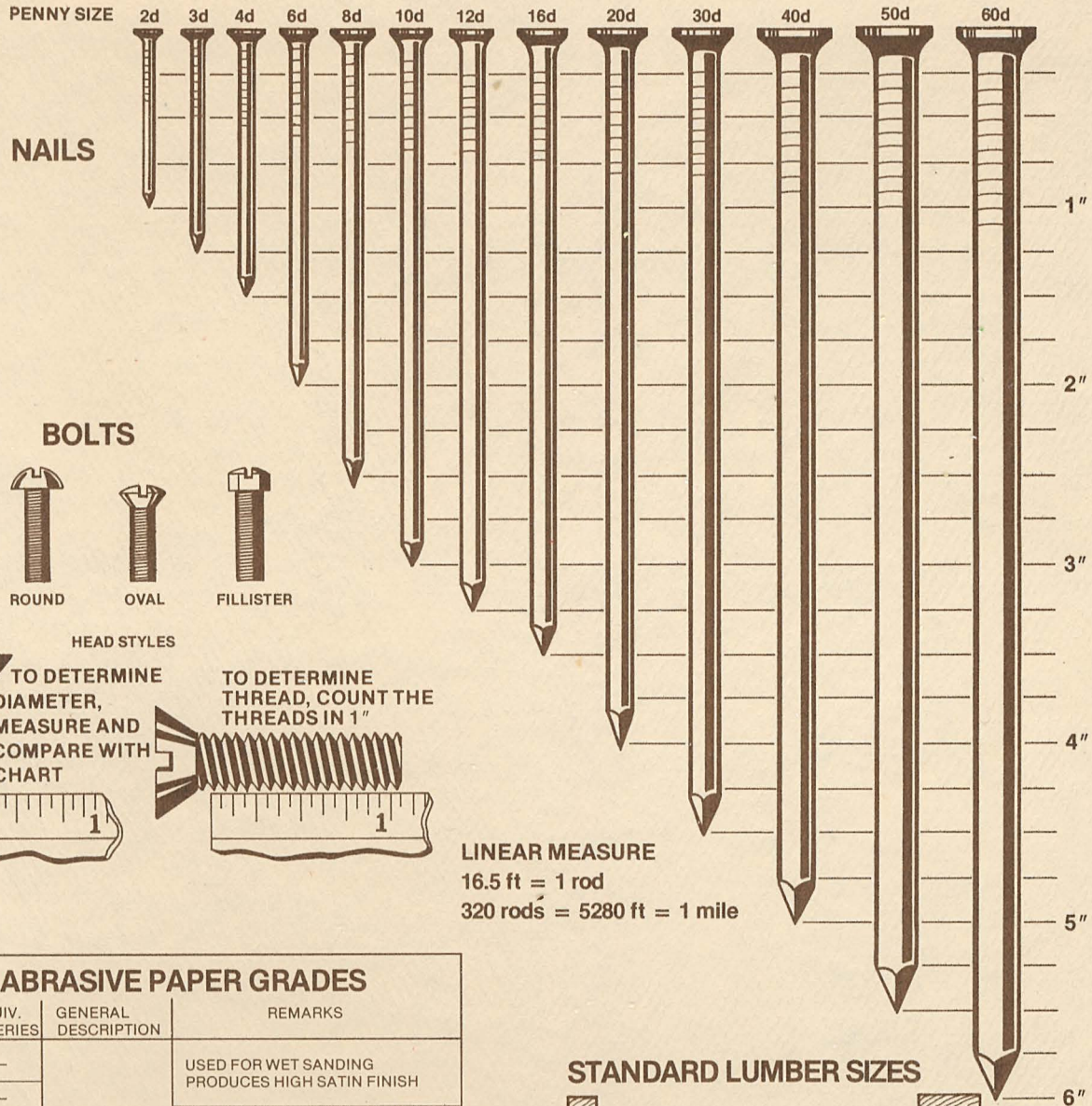
Popular Mechanics

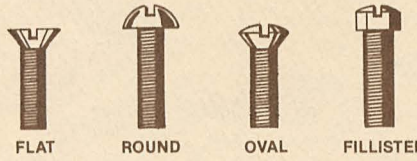
do-it-yourself encyclopedia

SHOP GUIDE

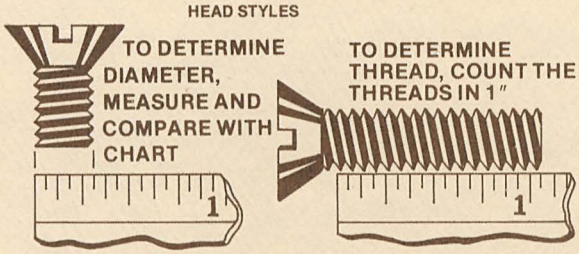
NAILS



BOLTS



HEAD STYLES



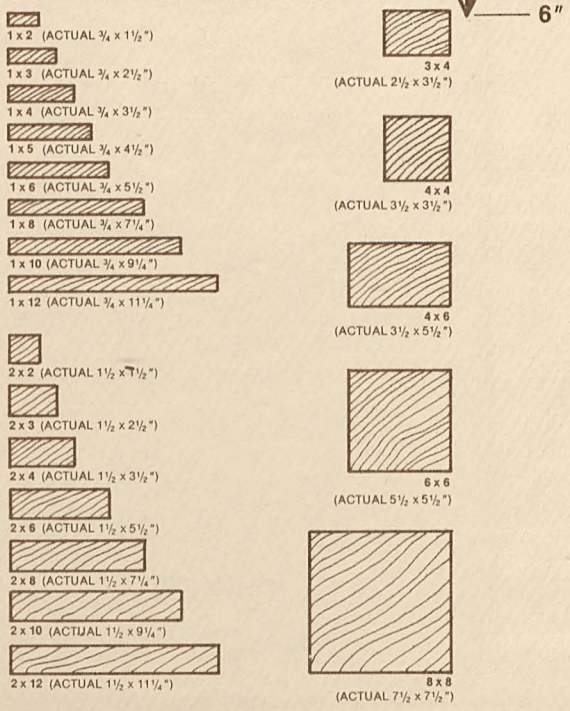
LINEAR MEASURE
16.5 ft = 1 rod
320 rods = 5280 ft = 1 mile

ABRASIVE PAPER GRADES

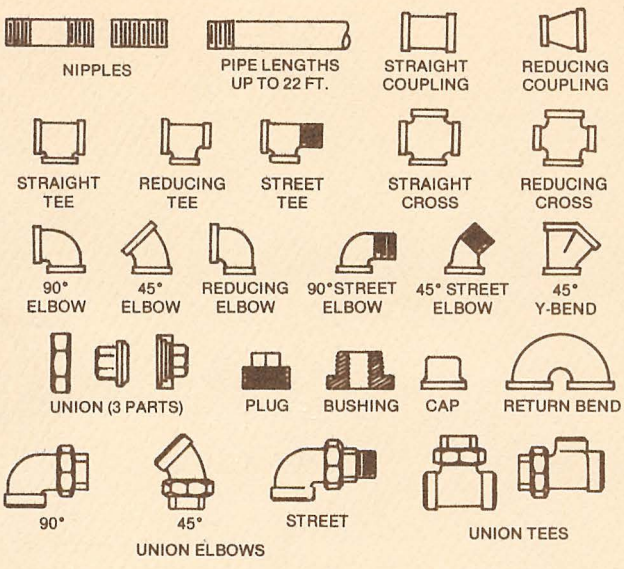
GRIT	EQUIV. "O" SERIES	GENERAL DESCRIPTION	REMARKS
600	—	SUPER-FINE	USED FOR WET SANDING PRODUCES HIGH SATIN FINISH
500	—		
400	10/0		GENERAL RANGE OF ABRASIVE PAPERS USED FOR WET SANDING LACQUER AND VARNISH TOP COATS
360	—		
320	9/0		
280	8/0	VERY FINE	USED FOR DRY SANDING ALL FINISHING UNDERCOATS. THESE GRADES WILL NOT SHOW SANDING MARKS
240	7/0		
220	6/0*		
180	5/0	FINE	FOR FINAL SANDING OF BARE WOOD. GOOD FOR SMOOTHING OLD PAINT
150	4/0*		
120	3/0	MEDIUM	USE FOR GENERAL WOOD SANDING. GOOD FOR FIRST SMOOTHING OF OLD PAINT, PLASTER PATCHES
100	2/0*		
80	1/0		
60	1/2*	COARSE	USE No. 1/2 FOR ROUGH-WOOD SANDING. No. 1 IS COARSEST PAPER WHICH CAN BE USED TO ADVANTAGE WITH PAD SANDER
50	1		
40	1 1/2		
36	2	VERY COARSE	ALL TOO COARSE FOR PAD SANDERS. THESE GRADES REQUIRE HEAVY MACHINES AND HIGH SPEED TO CUT WELL
30	2 1/2		
24	3		

Grades generally supplied as Very Fine, Fine, Medium and Coarse

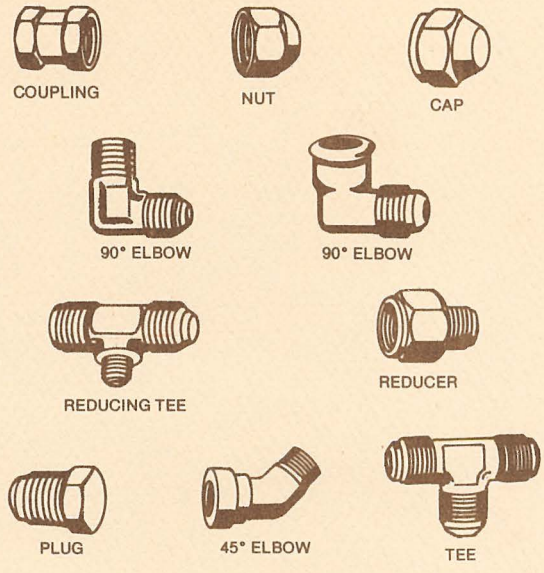
STANDARD LUMBER SIZES


1 x 2 (ACTUAL 3/4 x 1 1/2")
1 x 3 (ACTUAL 3/4 x 2 1/2")
1 x 4 (ACTUAL 3/4 x 3 1/2")
1 x 5 (ACTUAL 3/4 x 4 1/2")
1 x 6 (ACTUAL 3/4 x 5 1/2")
1 x 8 (ACTUAL 3/4 x 7 1/4")
1 x 10 (ACTUAL 3/4 x 9 1/4")
1 x 12 (ACTUAL 3/4 x 11 1/4")
2 x 2 (ACTUAL 1 1/2 x 1 1/2")
2 x 3 (ACTUAL 1 1/2 x 2 1/2")
2 x 4 (ACTUAL 1 1/2 x 3 1/2")
2 x 6 (ACTUAL 1 1/2 x 5 1/2")
2 x 8 (ACTUAL 1 1/2 x 7 1/4")
2 x 10 (ACTUAL 1 1/2 x 9 1/4")
2 x 12 (ACTUAL 1 1/2 x 11 1/4")
3 x 4 (ACTUAL 2 1/2 x 3 1/2")
4 x 4 (ACTUAL 3 1/2 x 3 1/2")
4 x 6 (ACTUAL 3 1/2 x 5 1/2")
6 x 6 (ACTUAL 5 1/2 x 5 1/2")
8 x 8 (ACTUAL 7 1/2 x 7 1/2")

PIPE FITTINGS



Here are the common steel pipe fittings. Nipples are simply short lengths of pipe threaded on both ends. Reducing fittings join two different sizes of pipe.



Compression fittings of the flared-tube type are the easiest for the novice to handle when working with copper tubing.

STANDARD STEEL PIPE
(All Dimensions in Inches)

Nominal Size	Outside Diameter	Inside Diameter	Nominal Size	Outside Diameter	Inside Diameter
⅛	0.405	0.269	1	1.315	1.049
¼	0.540	0.364	1¼	1.660	1.380
⅜	0.675	0.493	1½	1.900	1.610
½	0.840	0.622	2	2.375	2.067
¾	1.050	0.824	2½	2.875	2.469

SQUARE MEASURE

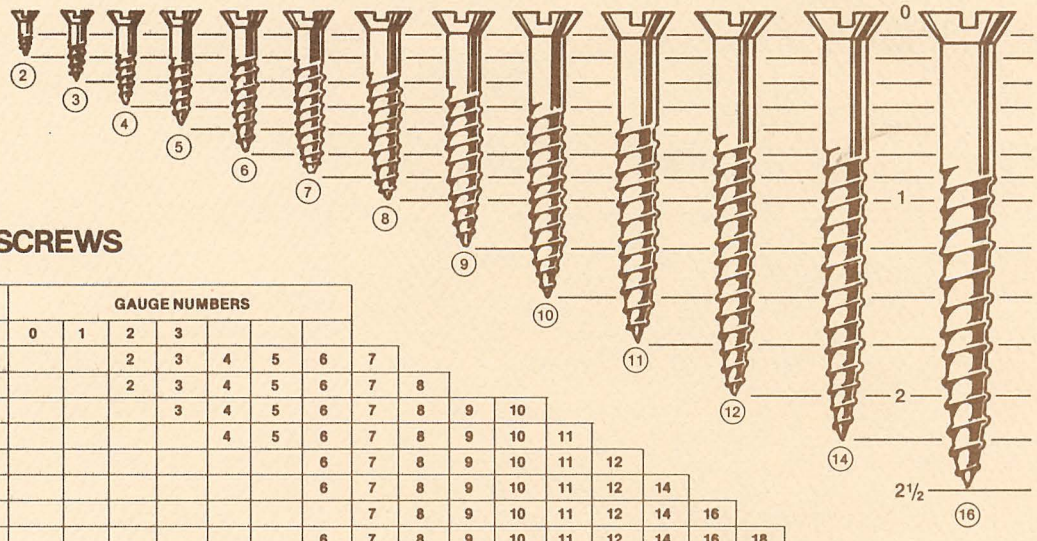
144 sq in = 1 sq ft
9 sq ft = 1 sq yd
272.25 sq ft = 1 sq rod
160 sq rods = 1 acre

VOLUME MEASURE

1728 cu in = 1 cu ft
27 cu ft = 1 cu yd

MEASURES OF CAPACITY

1 cup = 8 fl oz
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel



WOOD SCREWS

LENGTH	GAUGE NUMBERS																
¼ INCH	0	1	2	3													
⅜ INCH			2	3	4	5	6	7									
½ INCH			2	3	4	5	6	7	8								
⅝ INCH				3	4	5	6	7	8	9	10						
¾ INCH					4	5	6	7	8	9	10	11					
⅞ INCH							6	7	8	9	10	11	12				
1 INCH							6	7	8	9	10	11	12	14			
1¼ INCH								7	8	9	10	11	12	14	16		
1½ INCH							6	7	8	9	10	11	12	14	16	18	
1¾ INCH									8	9	10	11	12	14	16	18	20
2 INCH									8	9	10	11	12	14	16	18	20
2¼ INCH										9	10	11	12	14	16	18	20
2½ INCH													12	14	16	18	20
2¾ INCH														14	16	18	20
3 INCH															16	18	20
3½ INCH																18	20	24
4 INCH																18	20	24

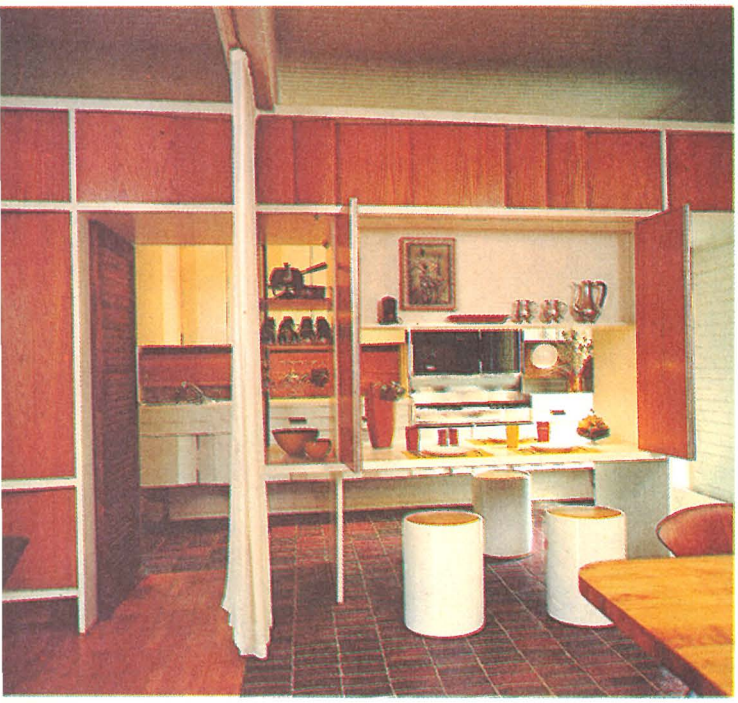
WHEN YOU BUY SCREWS, SPECIFY (1) LENGTH, (2) GAUGE NUMBER, (3) TYPE OF HEAD—FLAT, ROUND, OR OVAL, (4) MATERIAL—STEEL, BRASS, BRONZE, ETC., (5) FINISH—BRIGHT, STEEL BLUED, CADMIUM, NICKEL, OR CHROMIUM PLATED.

SPECIAL COMPARTMENTS in this catchall closet for sportsmen hold all the gear that doesn't seem at home anywhere else. The tall section even holds skis. For details, see page 2910.

In this volume . . .

HERE'S ANOTHER great storage idea—a train board that slides under the bed. Equipment goes in a cupboard that forms the headboard. See the big section on storage ideas, page 2910.

BEHIND THOSE handsome walls on the right is storage galore. There's room for books, records, stereo, a movie projector and much more. Above and below you see the pass-through between kitchen and living room, with doors open and closed. See the article on page 2924.



THIS BUILT-IN is truly multipurpose—a room divider, storage wall, hi-fi center and worktable all in one. A counter adds workspace. See the article starting on page 2910.

TOILETRIES kept on top of the tank will stay put when corraled by this smart bathroom accessory. You can turn the spindles, or buy them readymade. It's a handsome project that will challenge your craftsmanship. See page 3067.

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a complete how-to guide for the homeowner, the hobbyist—and anyone who enjoys working with mind and hands!

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- weekend projects
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- hand-tool skills
- power-tool know-how
- shop-made tools
- car repairs
- car maintenance
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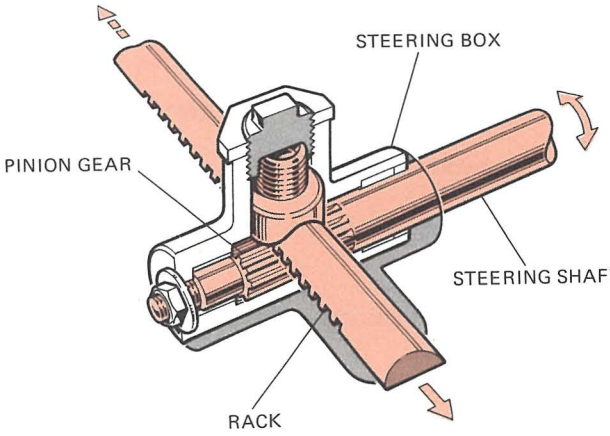
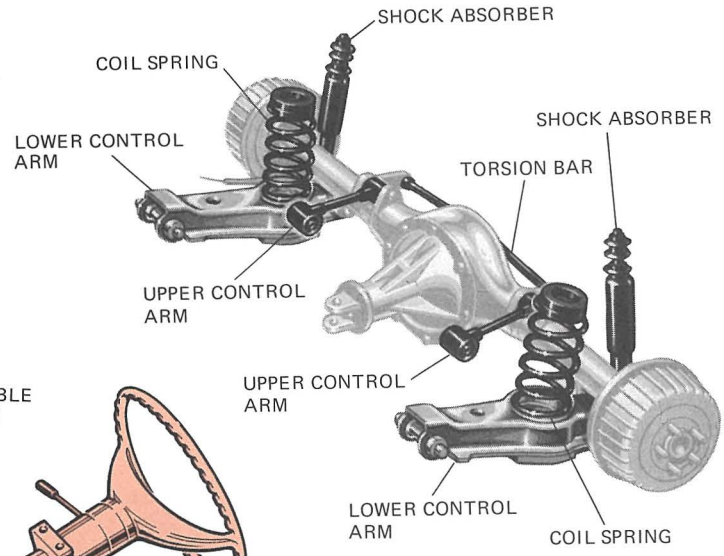
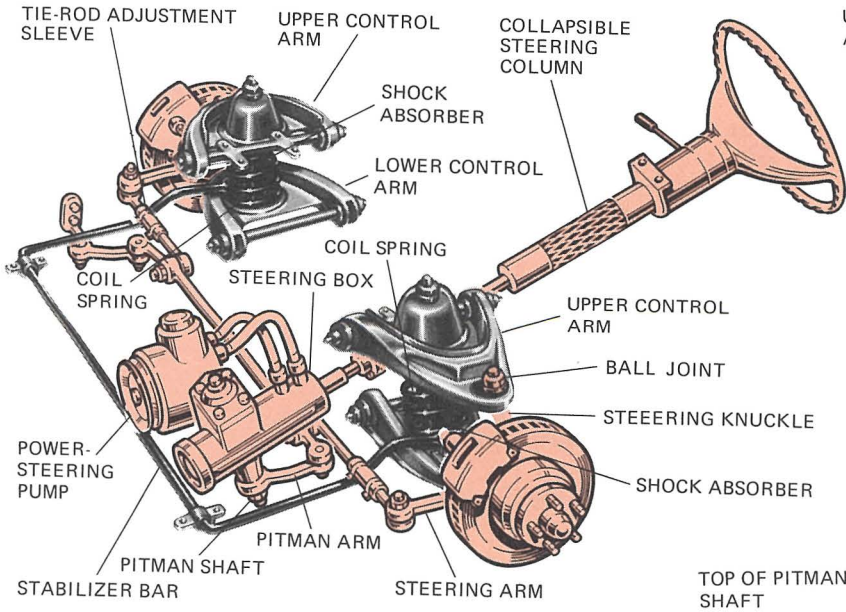
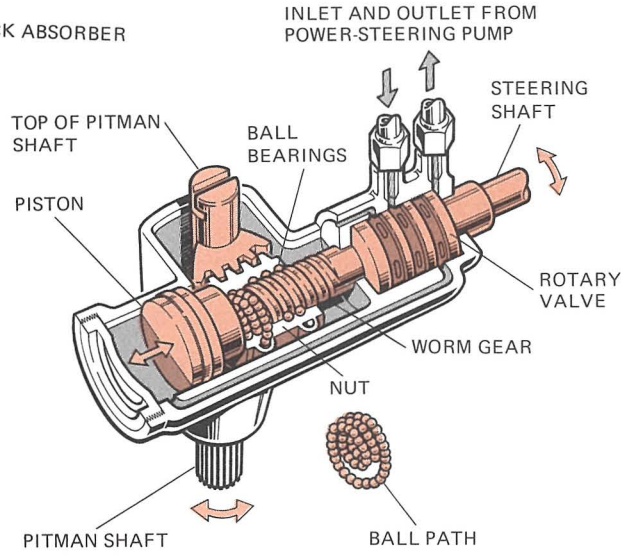
Keep your steering and suspension systems working

By MORT SCHULTZ









SEE ALSO

Autos, repair . . . Brakes, auto . . . Lubrication, auto . . . Ramps, auto repair . . . Tires . . . Tune-up, auto . . . Wheels, auto

■ A CAR'S STEERING system and suspension system are two distinctive systems. However, if any two systems of a car are wedded, they are steering and suspension. One won't work well without the other.

Taken together, steering and suspension consist of many parts that have a total effect on vehicle control and stability. Furthermore, the systems have built-in geometric angles that have to be maintained to attain maximum tire life.

Despite the apparent complexity of the steering and suspension systems, no one is in a better position to know when trouble arises than the driver. Awareness of the vehicle's response is necessary since a problem that develops will telegraph itself.

For example, a vibration, which is a shimmy in the car's front wheels, frequently develops if there's a malfunction. You feel vibration as a continuous shaking sensation in the steering wheel, in the floorboard, or in the seat while driving at a particular speed, usually between 50 and 70 mph. It continues as long as the speed is maintained, and may disappear when speed is exceeded or reduced.

Vibration will occur if shock absorbers, ball joints or steering linkage are worn, or if the front end is out of line.

Don't confuse vibration with tire tramp, or thump, which is a cyclical thump-thump-thump sensation that is felt at about 25 mph. Thump may be brought about by a bulged tire, which should be replaced, or by worn shock absorbers.

Important: Most of the operational conditions mentioned in this chapter can result from improper tire pressure. Check inflation first. You may solve your problem easily and at no expense.

Other signs that reveal the existence of a suspension or steering problem are: pulling to one side; tires that wear more on one side than on the other; tires that develop "cupped" areas; a car that bounces or bottoms when going over railroad tracks; a car that leans or sways when rounding a corner; a car that wanders (steers erratically); noise (crunch) in the front; steering that feels hard; and excessive play in the steering.

Some of the problems—wandering, noise and hard steering—occur because of lack of lubrication. If this is discounted, you will have to look elsewhere for the cause.

The rest of this article discusses what you should know about those areas of a car's steering and suspension which cause the greatest number of problems.

shock action

The purpose of shock absorbers is not, strangely enough, to absorb shock. This is done by the springs. Shock absorbers control spring oscillation, which would cause tires to bounce.

The typical shock absorber contains a piston inside a cylinder. The cylinder has valves on its lower end. The cylinder-piston assembly is encased in a large sealed tube that is filled with hydraulic fluid.

The valves permit rapid passage of hydraulic fluid between the cylinder and tube as the shock absorber is compressed (jounces). On decompression (rebound), valves close, and return valves open to allow fluid to return to the cylinder.

In time, one of three things happens to make a shock absorber ineffective:

1. Seals rupture and fluid is lost.
2. The shock absorber breaks loose.
3. Internal parts wear out.

A sign of shock absorber damage is when a car bounces as you drive over railroad tracks and bumps. Keep an ear tuned for rattling noise that would signify a loose shock.

Try tightening loose shocks. If this doesn't work, the bushing is worn. Replace the shock.

Periodically check the outside cases of each shock absorber. If fluid is leaking from the seal, replace the shock.

Don't replace all four shock absorbers if one is damaged. However, replace both shocks on the same axle to maintain equal action.

Clean dirt and grime from upper and lower mounting bolts, and apply a liberal quantity of penetrating oil. Place a jack close to the spring under the lower control arm (front shock) or on the rear axle (rear shock) to relieve pressure on the shock.

Remove lower and upper fasteners. If the upper fastener is not accessible from beneath the car, get to it through an opening in the fender housing in the engine compartment (front shock) or through an opening in the trunk floor (rear shock).

Remove and replace the shock absorber, making sure that mounting bolts are secured as tightly as possible.

the language of alignment

Readjusting front-end alignment requires the use of a professional front-end alignment rack. Understanding terms used in reference to alignment will allow you to discuss a problem with your mechanic.

Front-end alignment refers to the correct relative position of the front wheels to obtain a true, free-rolling movement over the road without scuffing, dragging or slipping. The three most important angles that determine wheel alignment are camber, caster and toe-in.

Camber refers to the outward and inward tilt of the wheel. It is measured in degrees, which represent the amount that the centerline of the wheel is tilted from true vertical.

Positive camber is when wheels tilt outward at the top, and negative camber is when wheels tilt inward at the top. The car manufacturer's front-wheel alignment specification spells out whether wheels should be set for positive camber or negative camber by the letter P or N, respectively, or by the symbol + or −, respectively. If neither letter nor symbol is present, set wheel for positive camber.

If camber can be adjusted, it is done by adding or subtracting shims at the upper control arm shaft or by turning eccentric adjusting bolts. A gauge attached to the wheel tells when the setting is within specification.

Caster refers to the backward or forward tilt of the spindle support arm at the top of the wheel. Caster is a directional control angle measured in degrees showing the extent to which the centerline of the spindle support arm is tilted from true vertical.

Positive caster (P or +) is the backward tilt of the spindle support arm at the top. Negative caster (N or −) is the forward tilt of the spindle support arm at the top.

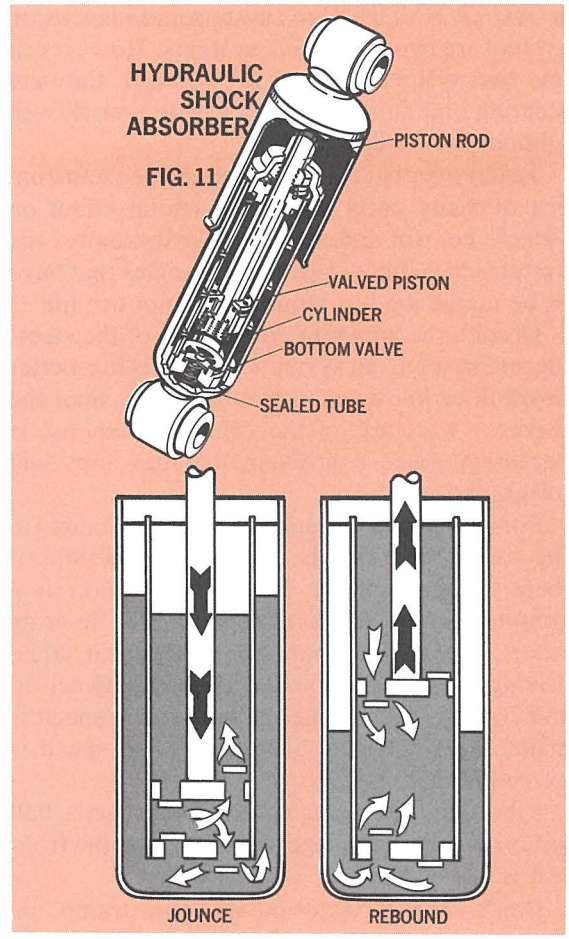
Correct caster allows the wheels to maintain a straight-ahead position and to return to a straight position from a turn. It also helps offset the effects of the crown built into most of the nation's roadways for drainage.

Excessive caster causes a car to pull to one side. It may also produce hard steering and shimmy. Insufficient caster causes wander.

In some cars, caster may be adjusted. In others, caster can't be adjusted, and the damaged part causing erratic caster should be replaced.

Toe-in refers to the shorter distance between the front of the front wheels and the greater distance between the rear of the front wheels. *Toe-out* refers to the greater distance between the front of the front wheels and the shorter distance between the rear of the front wheels.

Toe-in (and toe-out) is the primary front-end alignment angle affecting tire wear. Adjusting the angle compensates for wear in the steering.



HERE'S A TYPICAL shock absorber. Bottom drawings show what happens to oil in jounce and rebound cycle.

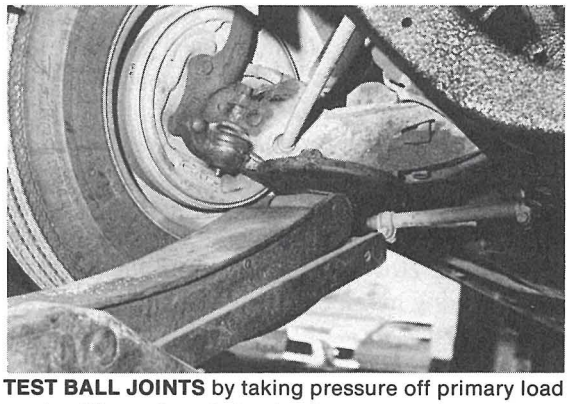
Toe-in (and toe-out) is measured with a toe gauge calibrated in inches. The adjustment is made by turning tie-rod adjusting sleeves. Rear wheels should also be checked for correct toe adjustment, since excessive toe-in or toe-out in the rear indicates a damaged part.

If you can't get front-end alignment to meet manufacturer's specification, examine steering and suspension components for damage. Look for bent steering linkage rods. Each component—tie rods, pitman arm, idler arm, and relay rods—should also be shaken. If there is play, the part should be replaced. Make a close examination of lower and upper control arms, steering knuckles, and spindles.

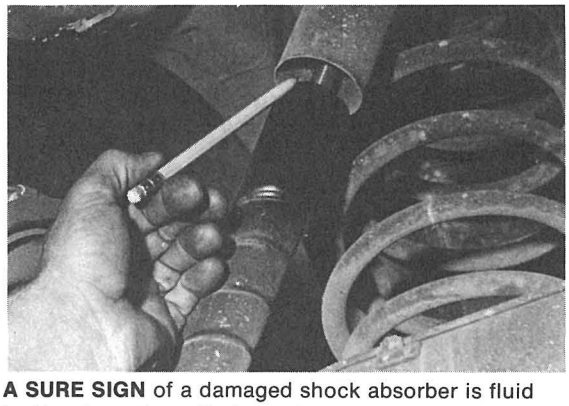
all about ball joints

The weight of your car rides on the suspension ball joints. Although ball joints are very reliable, they can wear out and be damaged.

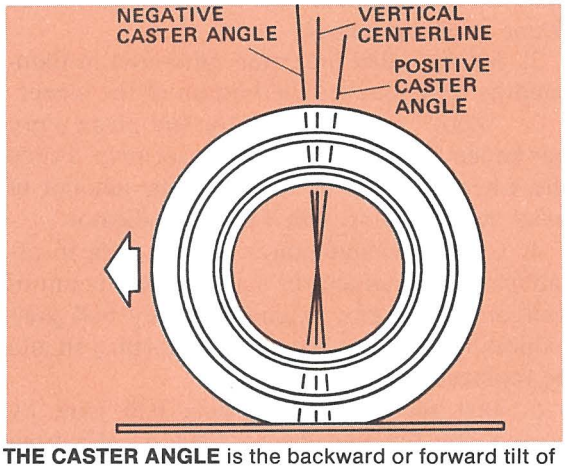
Since sudden ball-joint failure can result in loss of control, ball joints should be checked when trouble appears. Warning signs are vibra-



TEST BALL JOINTS by taking pressure off primary load carrier. Shown here is torsion-bar suspension.

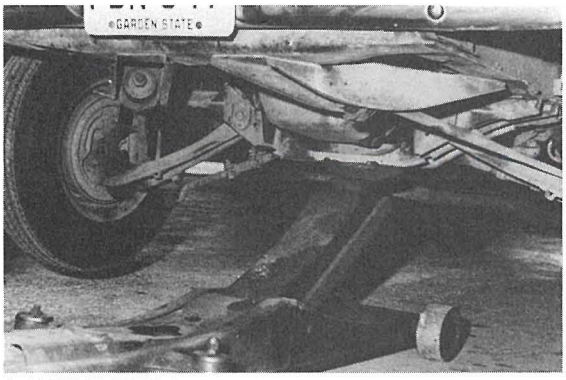


A SURE SIGN of a damaged shock absorber is fluid leaking from the cylinder at the seal.

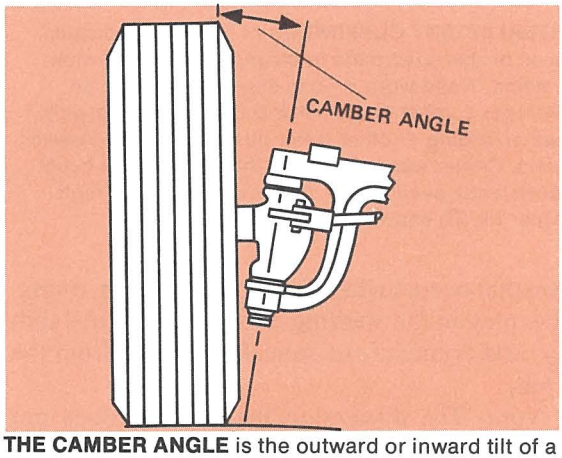


THE CASTER ANGLE is the backward or forward tilt of the spindle support arm.

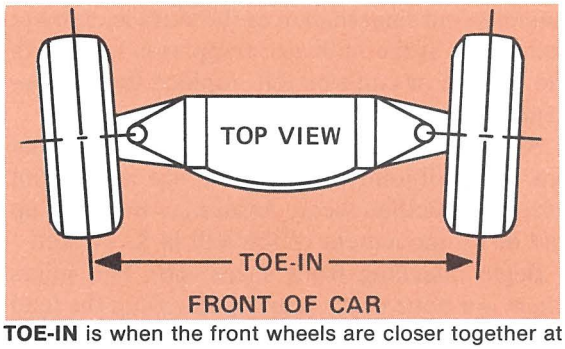
CHECK THE STEERING LINKAGE for looseness by grasping and shaking each of the rods.



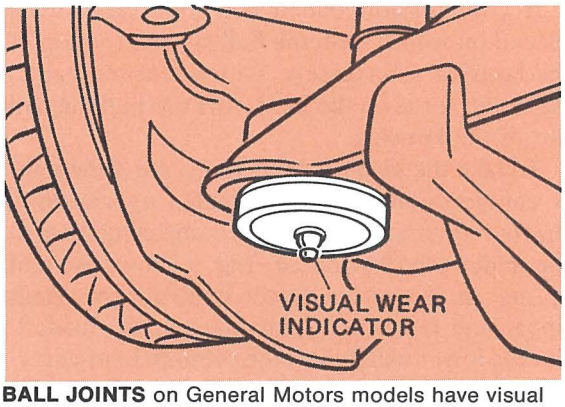
A JACK UNDER the cross member takes the pressure off the upper, compression-loaded joint.



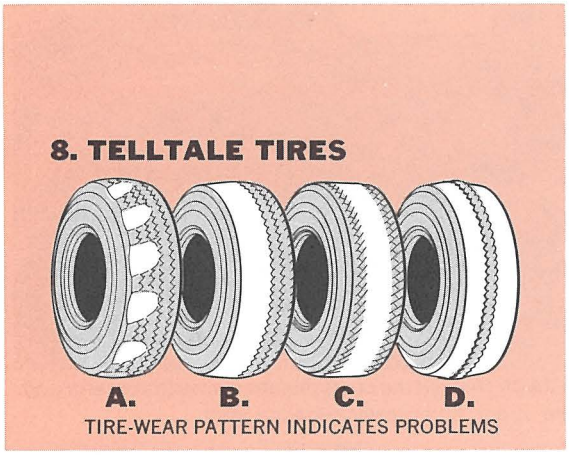
THE CAMBER ANGLE is the outward or inward tilt of a wheel, measured in degrees.



TOE-IN is when the front wheels are closer together at their front edges than their rear edges.



BALL JOINTS on General Motors models have visual wear indicators that makes them easy to check.



INTERMITTENT CUPPING (A) of the tread indicates loose or damaged parts in steering and suspension systems. Tread worn on one side (B) indicates an improper camber angle; wear on half the tread with feather-edging of other tread ribs indicates excessive toe-in. Center wear (C) means that the tire has been consistently overinflated. Outside wear with a high center rib (D) shows underinflation.

tion that occurs when the car hits a bump, excessive play in the steering wheel, vehicle instability, and crunching or squeaking noises from the front.

Note: The discussion that follows does not apply to late model GM cars. Ball joints in these have a built-in wear indicator that is checked by running your fingernail over the surface of lower ball joints. If the indicator (nipple) is level with the surface or can't be felt, replace the component.

Automobile manufacturers recommend that you test ball-joint axial play to see if the joint exceeds specified wear. Axial play refers to up and down movement of the ball in its socket.

Begin checking front suspension ball joints (there are none in the rear) by releasing the load on the joint. Load is applied in one of two ways: compression or tension.

A compression-loaded ball joint has forces placed on it that push the ball against the top of the housing. Conversely, with a tension-loaded ball joint, force on the joint works to pull the ball out of the housing.

To take the load off a ball joint, see if the joint is compression or tension-loaded by checking the four illustrations here and comparing them to the underside of your car. Fig. 9 shows the coil spring on top of the lower control arm. Both upper and lower ball joints are tension-loaded, but the lower ball joint is the primary load-carrying member. It absorbs practically the whole load, and will fail first.

To relieve pressure on the lower ball joint, raise the wheel by placing a jack beneath the lower control arm as close as possible to the centerline of the coil spring.

Figs. 10 and 11 show tension-loaded upper ball joints and compression-loaded lower ball joints. The system seen in Fig. 10 is coil-spring suspension, while the setup seen in Fig. 11 is torsion-bar suspension. However, pressure on the primary load-carrying member is relieved the same way for both.

The lower ball joint is the primary load-carrying member. Raise the wheel by placing a jack as close to the wheel as possible.

Fig. 12 shows another suspension configuration, with the coil spring on top of the upper control arm. The upper ball joint is compression-loaded and is the primary load-carrying member.

To relieve pressure, place a support wedge between the upper control arm and front crossmember, and raise the wheel by positioning a jack under the crossmember.

ball-joint axial play

1. Jack the wheel up high enough to relieve pressure on the car's rebound bumpers, which are rubber grommets that are mounted on the frame to absorb shock.
2. Set up a dial indicator calibrated in thousandths so it touches the bottom of the wheel.
3. "Zero" the dial indicator and place a pry bar beneath the wheel and tire assembly. Force the wheel and tire up and note the amount of axial movement recorded by the indicator.
4. Consult manufacturer service data to establish the manufacturer's allowable amount of ball-joint axial play. Generally, any ball joint exhibiting play in excess of .050-inch play should be replaced.
5. Test the nonload-carrying ball joint by grasping the tire and wheel at the top and bottom and shaking it in and out. If there is movement, this ball joint should be replaced, too.

power-steering problems

When your power steering isn't acting as it should, steering becomes difficult, or noise, binding or shimmy occurs. Troubleshooting a power-steering problem is done in the following way:

1. Make sure tires are properly inflated.
2. Check drive-belt tension. A loose belt will create lack of power assist, intermittent assist and noise.

3. If noise is coming from the power-steering pump and fluid reservoir, let the engine idle and pour water over the drive belt. If the noise ceases or changes pitch, it is being caused by the belt or pulley.

If water has no effect on noise, shut off the engine and loosen the drive belt. Start the engine. If there is no noise, the trouble is with the power-steering pump. However, if noise continues with the drive belt loosened, it's being caused by the alternator or water pump.

4. Check the power-steering fluid level. If fluid is needed often, look for a leak.

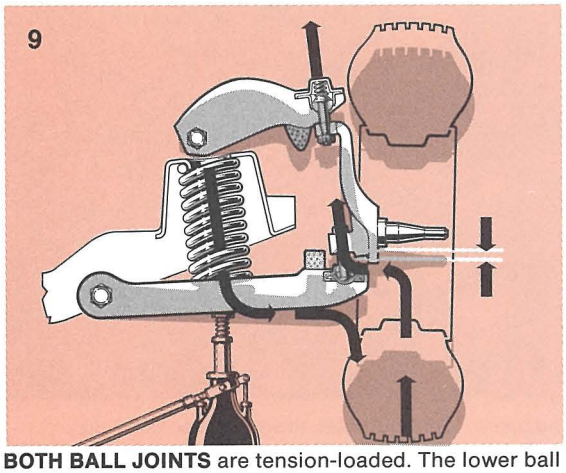
Clean off hydraulic lines, pump and fluid reservoir. With the engine idling, turn the steering wheel all the way to the right and then all the way to the left. Don't hold the wheel at either extreme.

Turning the wheel forces hydraulic fluid through the steering system under extreme pressure and causes fluid to leak from a defective part. Examine parts.

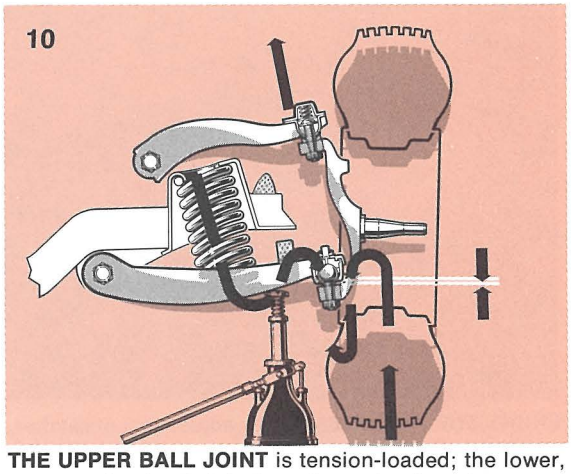
5. If the car is difficult to steer only at low speed, the problem is probably a defective control valve. This valve provides full hydraulic pressure at lower speeds.

The control valve, which may be sticking, might be freed by revving the engine a few times to build up hydraulic pressure, which loads up the control valve.

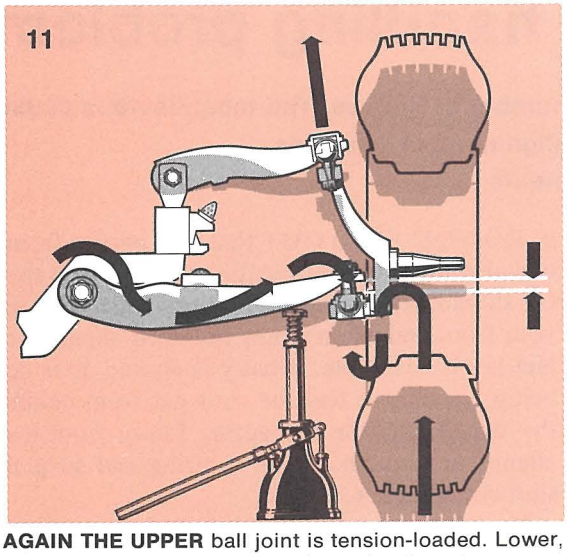
6. At this point, troubleshooting a power-steering problem involves making pressure tests with a powersteering pressure gauge. Higher than specified pressure points to a restriction in the system. Lower than specified readings indicate a bad pump or an internal leak.



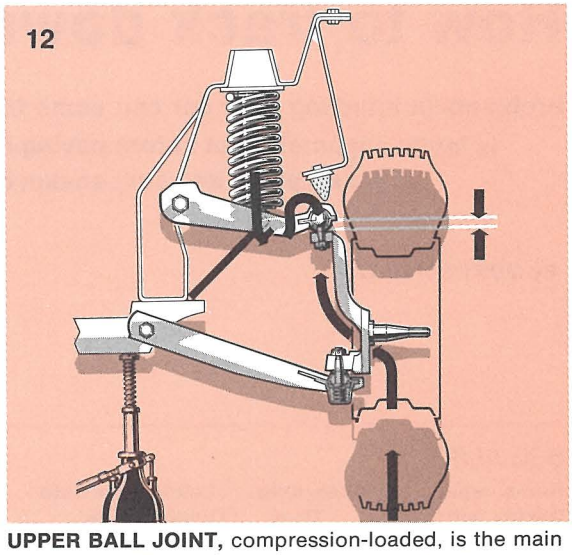
BOTH BALL JOINTS are tension-loaded. The lower ball joint is the primary load carrier.



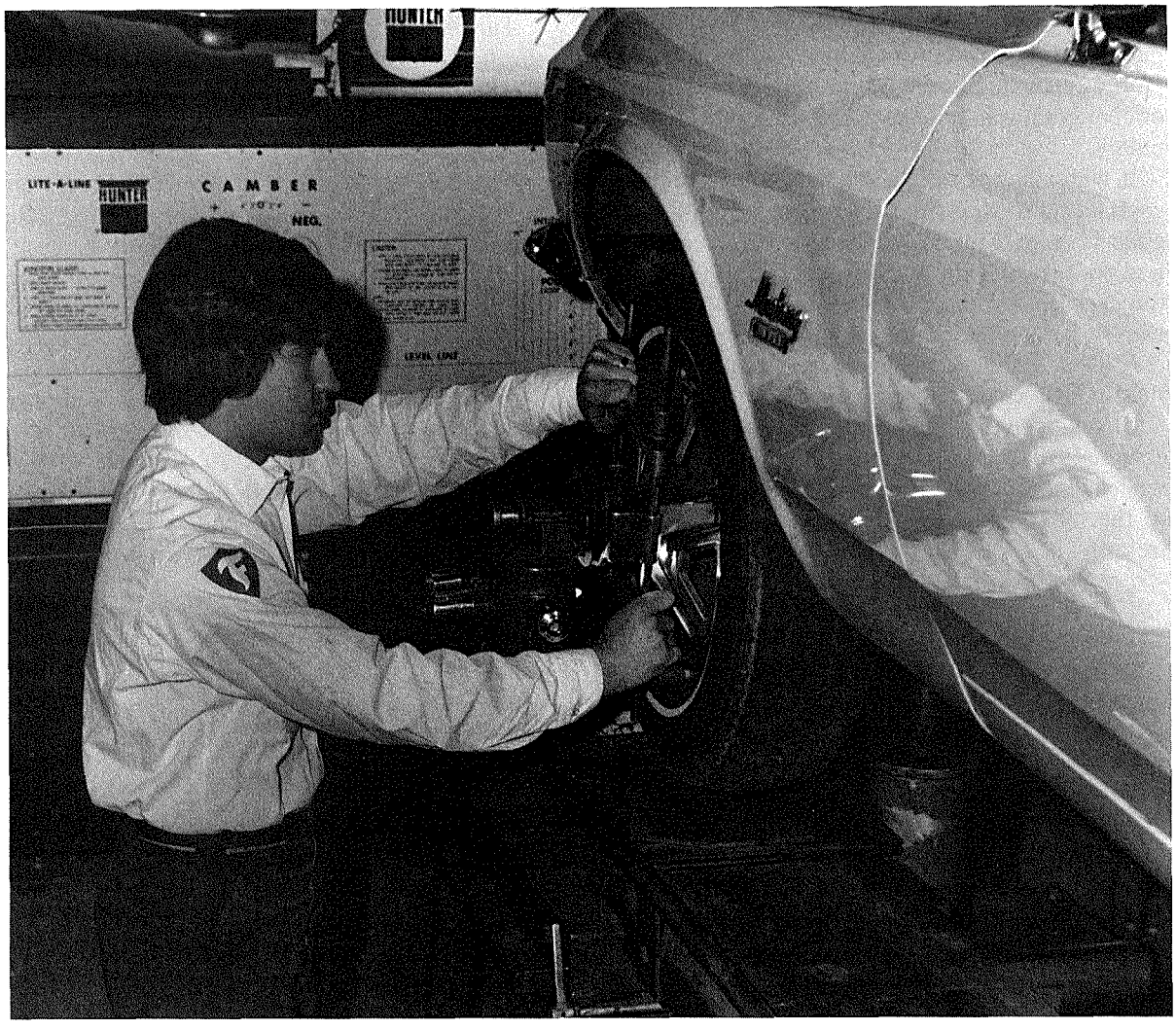
THE UPPER BALL JOINT is tension-loaded; the lower, compression-loaded, is the primary load carrier.



AGAIN THE UPPER ball joint is tension-loaded. Lower, compression-loaded, is the primary load carrier.



UPPER BALL JOINT, compression-loaded, is the main load carrier. The lower joint is tension-loaded.



FRONT-END ALIGNMENT is the adjustment of camber, caster and toe-in. When adjusted to spec, most handling problems are eliminated. There are other things to check before you decide to pay for a costly front-end alignment, however. By getting a feel for your car, you can begin to do some of your own diagnosis.

How to track down a handling problem

Problems in handling your car can come from a number of causes. The most obvious cause is faulty alignment. But before paying for an alignment, check some of the steering and suspension components

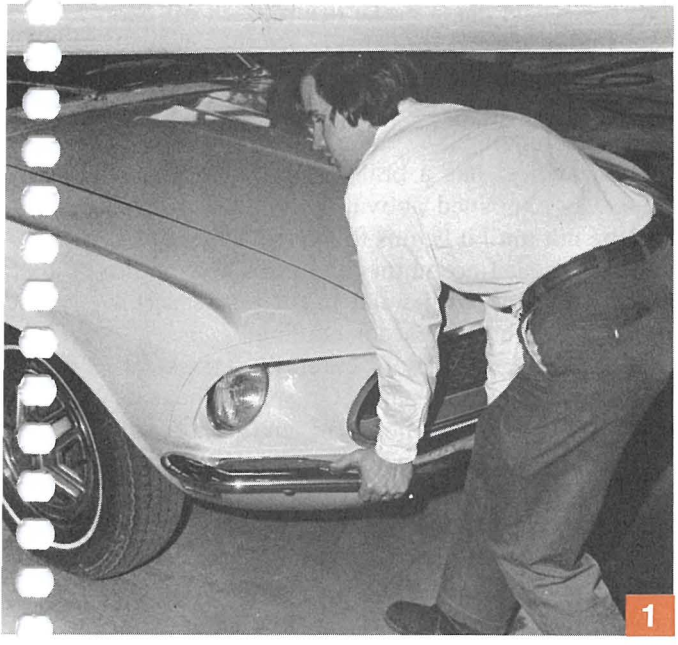
By MORT SCHULTZ

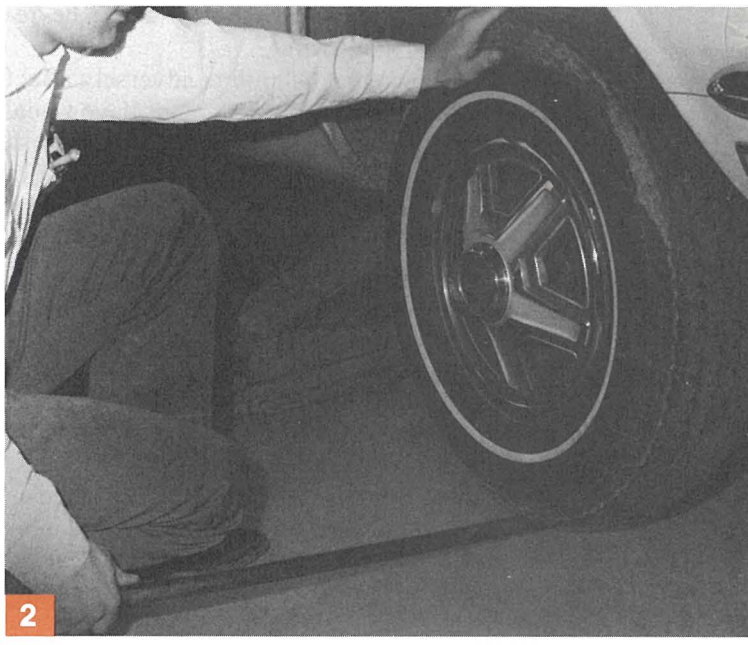
SEE ALSO

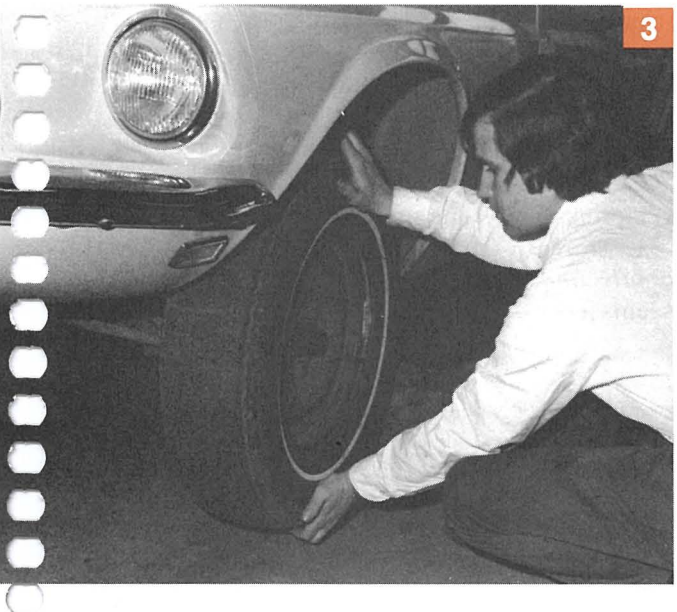
Autos, repair . . . Brakes, auto . . . Lubrication, auto . . . Ramps, auto repair . . . Tires . . . Tune-up, auto . . . Wheels, auto

■ DO YOU FIND OUT that you need a front-end alignment by waiting for your tires to wear? Or should you spend money regularly to align your front end when it may not need alignment? Neither is advisable. What you should do is develop a sensitive feel for your car from behind the wheel. Before suspecting faulty front-end alignment, though, check steering and suspension components.

If you see an obvious oil leak from a shock absorber, seals have probably failed and the







1. TO CHECK whether shocks are doing their job of damping up and down movement, jounce the car at each corner and observe whether the movement stops quickly.

2. EXCESSIVE PLAY in ball joints: For a quick test, try to move wheel up and down vertically. A "clunk" indicates looseness probably in excess of tolerances.

3. TOO MUCH side-by-side play in the wheel can also be a tell-tale sign. In this case you should probably have your mechanic do a wheel-bearing adjustment.

4. TO SEAT the wheel bearings after a lubrication or replacement, it is best to spin the wheel as you carefully snug up on the spindle nut.

component should be replaced. A light film of oil is normal, so don't discard a good shock. If your car has new shock absorbers (less than a year old), keep in mind that recent developments in seals have lessened the likelihood of failure and leaking. But this doesn't eliminate the fact that shock absorbers wear out internally, so even if they don't show signs of leaking, check for wear. Give the car a jounce at each corner.

If up-and-down movement stops quickly, the shock is probably okay. But if the car bounces

two or more cycles, the shock should be removed for further testing.

Worn or damaged ball joints adversely affect handling. Ball joints of some models have visual wear indicators. If the seat of the nipple is flush with or inside the joint, the ball joint is worn. In other models ball-joint condition is checked by taking the load off the load-carrying member with a jack. In some cars, this will be the lower ball joint—in others it is the upper ball joint.

With the load relieved and wheel and tire off the ground, place a pry bar beneath the tire and apply an upward force. This tests the joint's axial (up-down) motion. Place your hand on top of the tire as you measure axial movement. If there is motion and a "clunk" as the pry bar is pushed up and released, suspect ball-joint wear. A simple cardboard gauge to measure ball-joint wear comes in a ball-joint repair kit called "Shimmy Stop."

Check front-wheel bearings next. Raise the front wheels so they hang free. Grasp a tire at the top and bottom, and push in and pull out. If more than very slight movement is felt, bearings may need adjustment.

Manufacturers recommend different ways of adjusting front-wheel bearings, and you should follow their instructions. Generally, however, you remove the hub cap, pull out and discard the cotter pin and pull off the spindle nut cap. Then spin the wheel and simultaneously run up the spindle nut until it is snug. This seats bearings.

If the wheel has a brake drum, back off one castellation slot. Turn back to the nearest cotter-pin hole and install a new pin—wrap its legs securely around the nut. Turn the wheel to check for binding.

If the wheel has a brake disc, bearings are seated as explained above. Then back off the spindle nut until it begins to loosen. Then run it up hand-snug. Loosen the nut until a hole in the spindle lines up with a slot in the nut. Insert a new cotter pin and test for binding.

With the car raised, look carefully at the steering linkage. Any bent parts? Grasp and shake tie rods, pitman arm, idler arm and relay rod. Looseness indicates a worn member that should be replaced.

Check tires for sidewall bulges that indicate damage to sidewall plies. Radial tires, of course, show a normal sidewall bulge. Adding air in excess of recommended pressure to eliminate the bulge will overinflate the tire and lead to excessive tread wear.

Incorrect tire inflation can be a chief cause of almost every type of troublesome symptom affecting handling. Make sure tires are inflated (when cold) to recommended pressure before road-testing your car.

Here is a basic road-test procedure listing symptoms and some most likely causes:

1. *Start by gripping your steering wheel tightly and driving at 15-20 mph.* If steering seems jerky—that is, if you feel the shock of one

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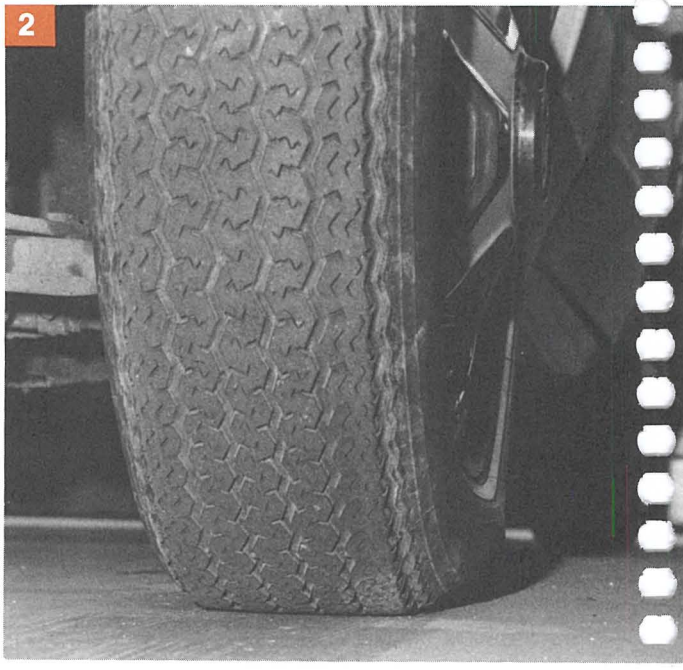
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wheel and then the other as they roll over slight bumps in the pavements, check for the following:

☐ Steering-gear damage, damaged steering linkage component, damaged suspension part (ball joint, spindle).

☐ Tire-wheel assembly imbalance.

☐ Out-of-round or cupped tires.

2. *Drive across railroad tracks on a slight angle at 15 to 20 mph, feeling for shimmy.* Shimmy is an oscillating motion of the front wheels at low speed that is felt as an almost uncontrollable movement of the steering wheel. Causes of shimmy include:

☐ Incorrect tire pressure.

☐ Loose or worn ball joints, steering linkage components or steering gear.

☐ Broken suspension coil spring or spring part.

3. *Drive about 60 mph with your hands placed lightly on the steering wheel.* The road should be as straight and as level as possible. You are testing for wander and wheel tramp.

Wander is the tendency of a car to drift slightly to one side and then to the other as you are attempting to steer a straight course. Wheel tramp is an oscillating motion in the front wheels at high speed that is felt as movement in the steering wheel, and in the seat of the pants.

The likely causes of wander are:

☐ Incorrect tire pressure.

☐ Loose or damaged ball joints, steering gear, steering linkage, spring parts or spindle.

☐ Front-end misalignment.

Conditions that usually cause tramp are:

☐ Incorrect tire pressure.

☐ Tire-wheel imbalance.

☐ Out-of-round or cupped tires.

☐ Loose or worn shock absorbers.

4. *At a speed of 30 to 40 mph, drive on a flat road with your hands off but near the steering wheel.* If your car runs straight for two tenths of a mile or more, you need *not* be concerned that the following conditions are causing pulling to one side:

☐ Front-end misalignment.

☐ Unequal brake adjustment.

☐ Front tires of unequal diameter because of wear or differences in design.

☐ Wheel-bearing misadjustment.

5. *Drive at about 30 mph on a safe, desolate stretch of road and weave rapidly from one side of the road to the other.* Determine if there is any difficulty in turning or recovery. Then make a few turns at different speeds in an empty parking lot. Notice if steering is hard. As the car comes out of a turn, release the steering wheel and see if the vehicle straightens. If a hard steering condition exists, or if steering return is poor, look for—

☐ Lack of lubrication on steering linkage, in steering gear or in ball joints.

☐ Front-end misalignment.

☐ Bad steering-gear adjustment, damaged steering or suspension component.

1. STEERING LINKAGES should be checked from the steering gear box all the way to front wheel spindles. Looseness or damage will cause handling problems.

2. CORRECT TIRE INFLATION is most important and affects handling profoundly. Sidewall bulge of radial tires with correct pressure is normal as shown here.

3. SPINNING WHEELS on car allows for accurate dynamic balancing of tire/wheel assembly. Improper balance can cause shimmy, tramp, jerky steering, uneven wear.

Troubleshooting by the seat of your pants

By MORT SCHULTZ

You have to discover the cause of those strange shimmies and shakes that are transmitted back to you through your car before you can even begin to work on the repair job

■ BAD VIBRATIONS, whether just faint quivers or car-shaking shimmies, mystify many car owners.

Sometimes a car will vibrate, mysteriously, only when idling. In other cases, cars may start shimmying at highly specific speeds—46 miles per hour, for example, or perhaps 53.

Sometimes an owner, in desperation, will return to a garage several times—and always drive home with the same nerve-wracking vibration. He'd probably be better off to find the source of the trouble himself.

When doing the diagnostic job yourself it's important to analyze the condition correctly. Most times you feel vibration in the steering wheel, but you may also feel it in the seat of your pants. Determine which, and then ask yourself under what circumstance you detect the sensation.

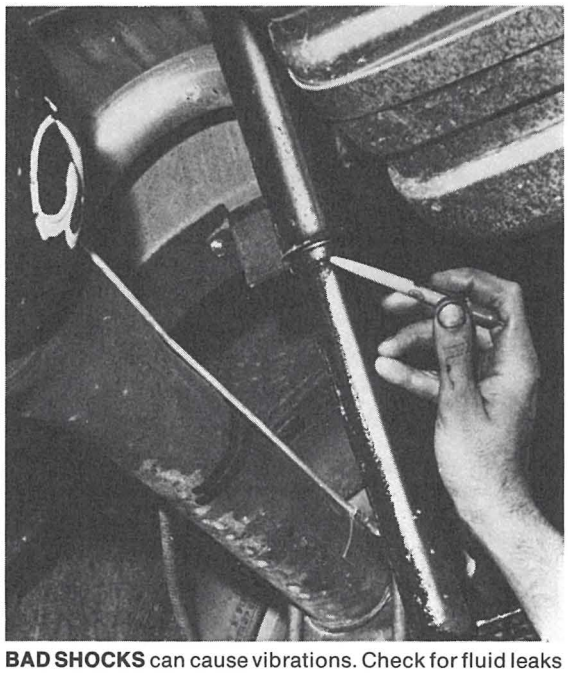
Don't mistake rough idle for a vibration, for example. Still other problems can cause a missing at high speed, slow speed or any speed. Again, this is not truly vibration. Missing and rough idle require engine service, such as a general tune-up, carburetor and distributor repair, or valve work.

There are three main causes of bad vibrations: front-wheel alignment, tire and wheel balance and shock absorbers, but many other things also cause vibration.

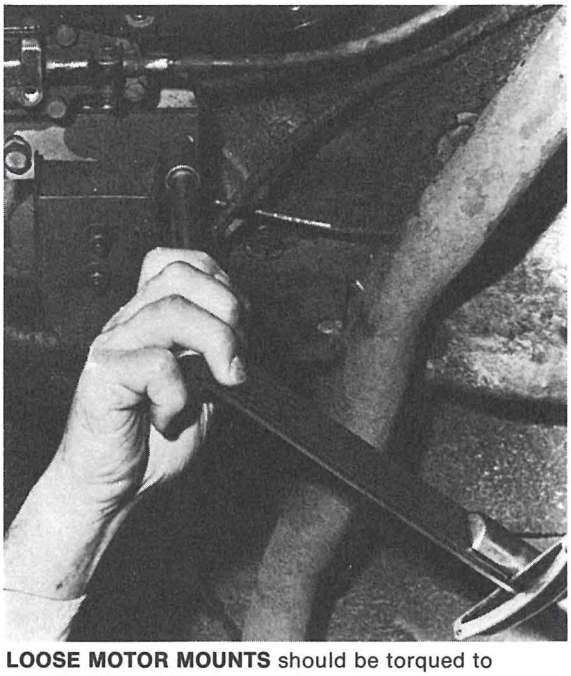
First check those areas that don't require a good deal of time or the use of professional equipment: Make sure that wheel lugs are properly tightened and that tire pressure is to manufacturer's specifications. Also examine tires for bulges. They can cause a vibration.

SEE ALSO

Autos, repair . . . Brakes, auto . . . Lubrication, auto . . . Ramps, auto repair . . . Tires . . . Tune-up, auto . . . Wheels, auto



BAD SHOCKS can cause vibrations. Check for fluid leaks and that mounts are tight.



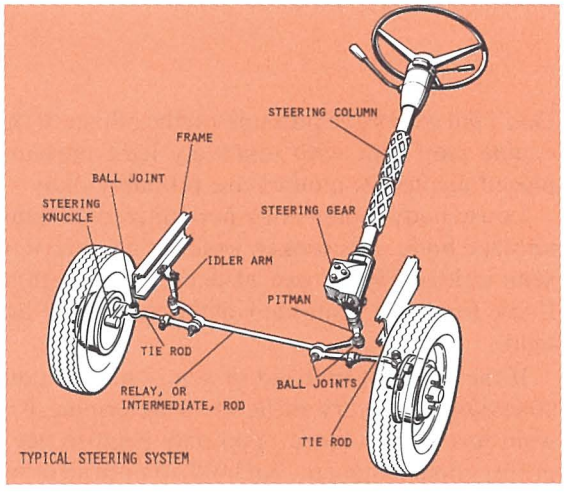
LOOSE MOTOR MOUNTS should be torqued to specifications. If broken, replace them.

Next, check shock-absorber mounts, and check for leaking fluid indicating shock absorbers that have failed. If the car is equipped with power steering, examine the power-steering pump. Look for a worn or loose pump drive belt, a pump that has loosened up on its bracket, a loose pump pulley and a loose crankshaft pulley. There should be no play in pulleys.

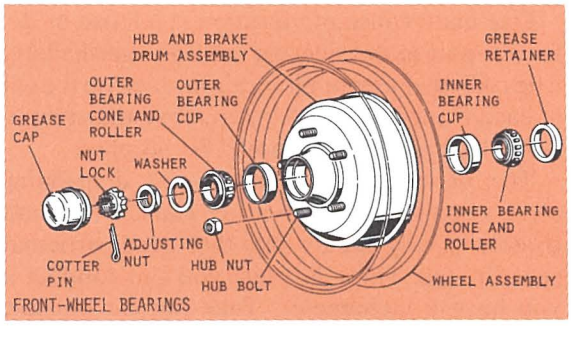
If the car has airconditioning, make sure the compressor hasn't loosened up. Keep in mind that any heavy part component that has come loose in the engine compartment can create vibration.

Obviously, vibration can also occur if motor mounts are loose or defective. One way of discovering them is to start the engine and allow it to idle, pull up on the emergency brake, put the car in gear and watch the engine. If the car has a manual transmission, the engine will stall, but if mounts are loose the engine will lift violently.

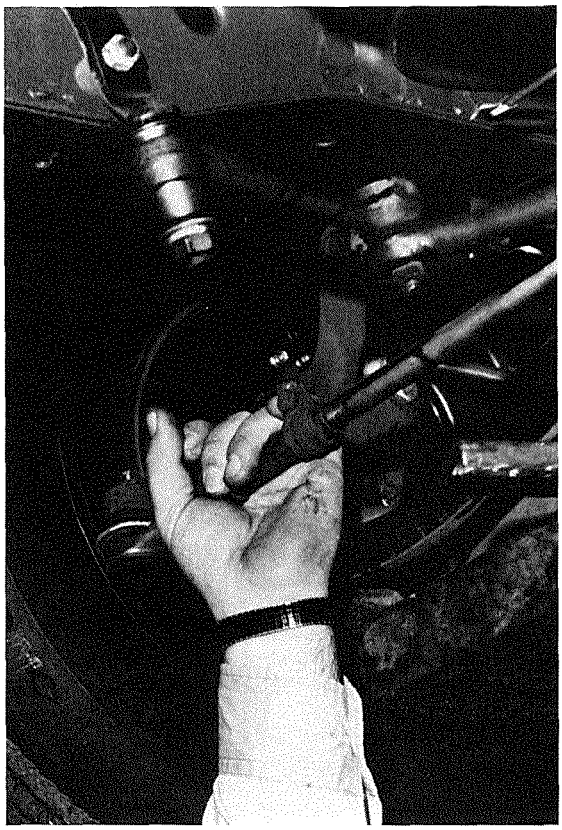
A more careful way of checking motor mounts, especially if the car is equipped with automatic transmission, is to place a hydraulic or hand jack beneath the oilpan or an accessible part of the block. Put a 2x4 between jack and engine. Carefully put pressure on the engine. If mounts are loose or defective, the engine will lift and separation will be seen between the mount and engine. Be judicious in this jacking test.



TYPICAL STEERING SYSTEM



FRONT-WHEEL BEARINGS



LOOSE TIE RODS can cause front-end shimmy. Also check steering idler and pitman arms.

FRONT-WHEEL BEARINGS that are too loose can be felt as shimmy. Torque to specs.

Don't put excessive pressure on the oilpan. If the engine won't lift with relatively light pressure placed against it, mounts are probably okay.

Loose body mounts of a nonunitized or semi-unitized body, and broken welds of a unitized or semi-unitized body can also create vibration. Look for body bolts and make sure they are tight.

If the car is of unitized or semi-unitized construction, it is very difficult to determine if a weld has broken loose. You may want to get a professional judgment, but hold off until all other conditions that can cause vibration are investigated.

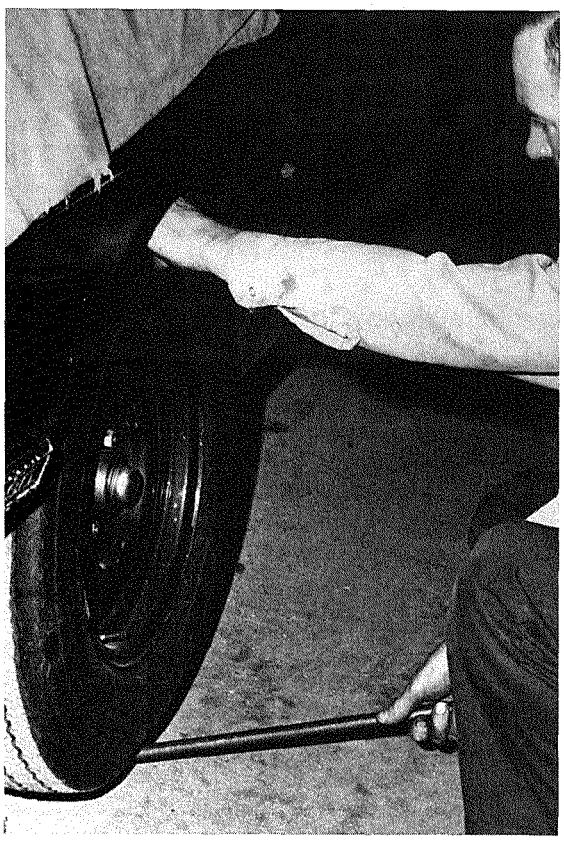
One main cause of vibration is a loose or defective part in the steering linkage—particularly a tie rod, idler arm or pitman arm. Jack up the car at each front wheel and try to move the components by hand. There should be no play.

The driveshaft is another part demanding close examination. Vibration caused by shaft trouble usually occurs only through a particular speed range. There is a test you can conduct if you have a tachometer. Take the car out and note the rpm or speed at which vibration is most pronounced. Now, shift to a different gear range and run the car at that same speed or rpm. If vibration occurs at the same speed or rpm regardless of the transmission gear range, the propeller shaft is *not* causing your vibration problem. If vibration decreases or is eliminated in that different transmission gear range, the shaft should be examined closely.

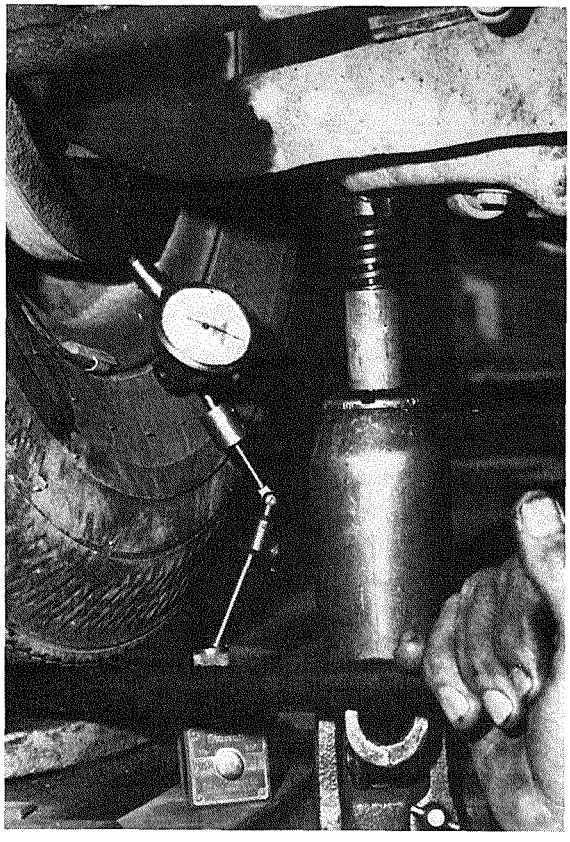
By using two different gear ranges, you permit the prop shaft to operate at different speeds.

Professional tools are frequently needed to cure a propeller shaft problem. For example, an angularity gauge is required to check shaft angularity. However, take the time to wipe down the shaft with gasoline or kerosene. You may find something that's causing the shaft to whip. Grasp the shaft and try to move it back and forth. There should be no play. If there is, universal joints may be defective.

Most other conditions that create vibration in a car require the use of professional equipment to detect and/or repair. But before you consult a professional, you may want to take the time to



CHECK BALL JOINTS after jacking car to remove load from ball joint you're working on.



PROFESSIONAL GAUGE must be used if it's necessary to check ball-joint looseness.

rule out the possibility of worn or loose front-wheel bearings.

Make sure first that bearings are properly adjusted. This requires the use of a torque wrench and the specification for your car. Specifications may be found in the manufacturer's service manual or a general automotive reference book.

Torque bearings to correct specification as you spin the wheel by hand. Now if vibration is still a problem, the bearings should be removed and examined for damage.

Causes of vibration—worn ball joints, out-of-balance wheels and tires or bent wheels, incorrect prop-shaft angularity or improper front-wheel alignment—may lead you to your service station or dealer. But do some work on your own first.

Ball joints should be checked particularly for vertical movement. It is possible for you to get an idea yourself if ball joints are badly worn. Take the load off the load-carrying ball joint. If the car's springs or torsion bars are attached to the lower control arms, it means that the lower ball joints carry the load. Place a jack as close as possible to the coil spring and raise the wheel until it clears the ground. This relieves the stress on the lower ball joint.

If springs are attached to the upper control arms, the upper ball joints are the load-carrying members. To take the load off them, lift the car by placing the jack beneath the frame cross member. Slip a pry bar beneath the tire and lift up. If there is more than barely perceptible movement, the ball joint is probably worn.

Each car manufacturer has set a maximum amount of vertical movement that the ball joints should have. If you suspect that the ball joints are causing vibration you should have them checked with an accurate dial indicator.

Although vertical movement of the part, which is also called its axial play, is most important, you should also have the part's horizontal (radial) movement checked. Generally, it should be no more than .250 inch, but manufacturer's specifications should be consulted. Vertical movement is of utmost importance, simply because a ball joint will usually wear out faster in that direction than horizontally.

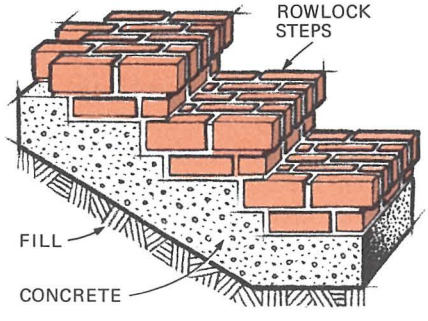
How to build brick and masonry steps

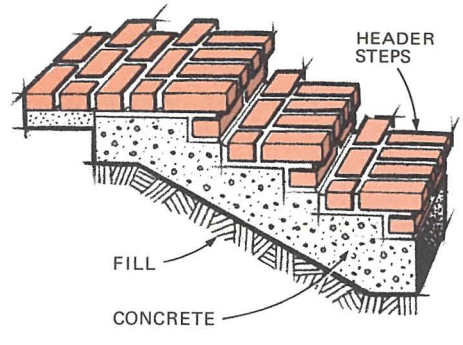
Exterior stairs made of either concrete or brick must be built on a good, solid foundation. You can do the calculations and the work yourself if you follow these instructions

■ EXTERIOR STAIRS should be designed and built as carefully as interior stairs. Their riser-to-tread ratios vary somewhat from interior-stair standards: Riser height on principal exterior stairs should be between 6 and 7 in., with a minimum tread of 12 in. In most outdoor situations, you'll have room to meet these specifications without going through complicated calculations. Good support for the weight of materials is essential to make steps that will be stable and won't crack through settling. If located over backfill, their footings must rest on undisturbed ground.

Common (building) bricks come in many colors and three grades; unless frost is extremely infrequent in your area, SW, for severe weathering, is the grade you'll want. Used brick is attractive in many applications, but it is necessary to check each individual brick for cracks. Even the smallest cracks can open up and cause problems. What comes closest to a standard size for common brick is 2¾ x 4½ x 8½ in. nominal. Actual size is ½ in. smaller in each dimension—the space taken up by ½-in. mortar joints between bricks. By using the nominal size in estimating the number of bricks needed, you get an automatic allowance for joint space—but check on the sizes stocked locally before estimating. Otherwise you may waste your time on computations and then find that what you need is not in stock at your supplier.

The space between your finished steps and house foundation must be sealed to prevent moisture from entering this area. This is done by filling the joint with oakum (a fibrous material), then applying tar or mortar caulk.



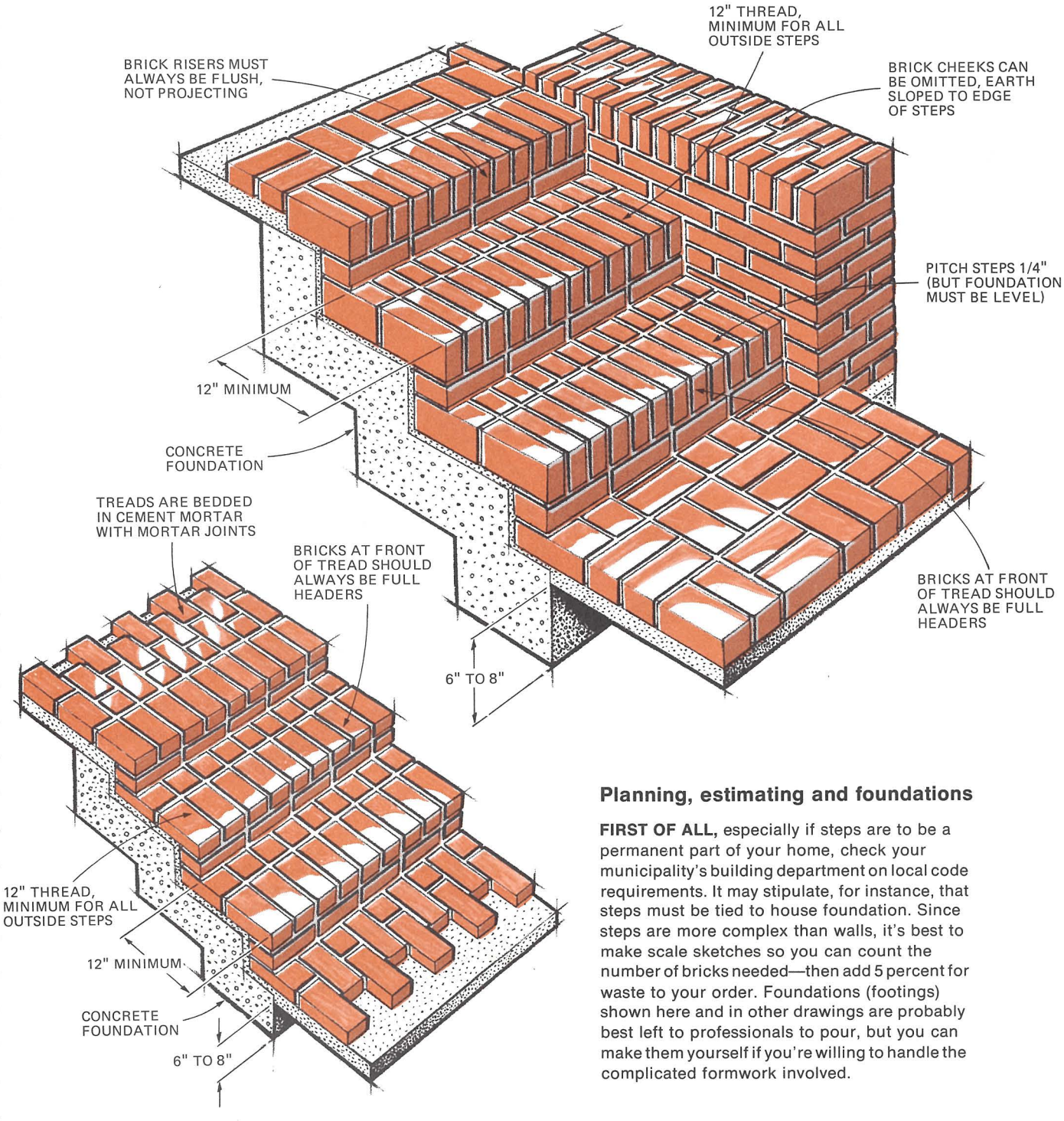


Bonds, mortar and joints

ROWLOCK STEPS and header steps are the two basic brick-step bonds. Either can be laid with slight nosing (overlap of tread); this should not exceed ½ in. Note that foundation for header steps in other drawings is simpler. Type M (high-strength) mortar should be used according to directions; mix only what you can use in 2½ hours. Mortar can be colored with lampblack or pigments. Work from the bottom up, laying bricks on a ⅜-in. mortar bed and checking with a level as you go. Flush mortar joints made with trowel edge will weather best. When mortar has set, rub with a clean brick to remove excess.

SEE ALSO

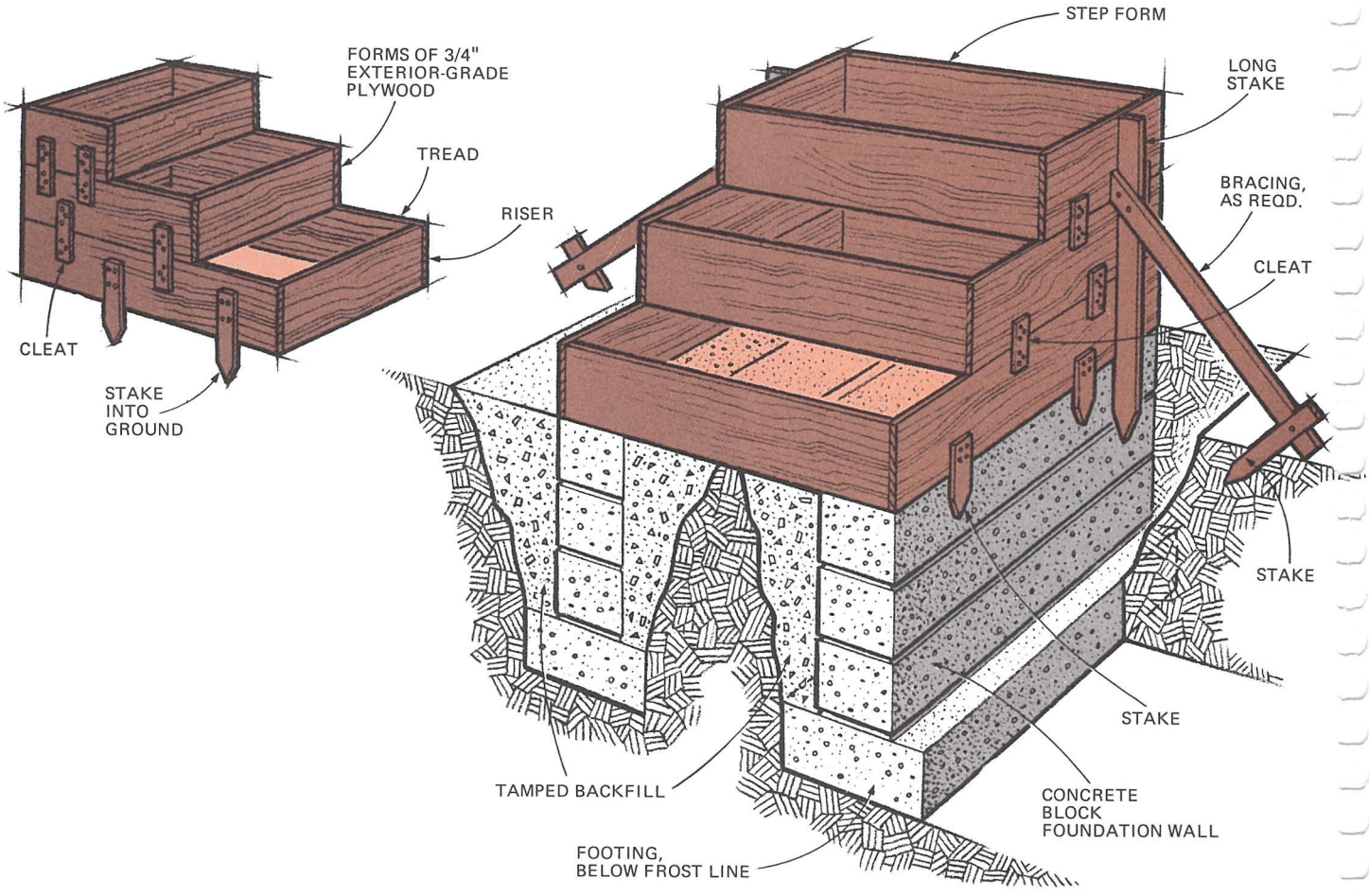
Basement stairwell . . . Concrete . . .
Home improvement . . . House additions . . .
Measurements . . . Railings . . .
Remodeling, exterior . . . Stairs


12" THREAD, MINIMUM FOR ALL OUTSIDE STEPS
BRICK RISERS MUST ALWAYS BE FLUSH, NOT PROJECTING
BRICK CHEEKS CAN BE OMITTED, EARTH SLOPED TO EDGE OF STEPS
PITCH STEPS 1/4" (BUT FOUNDATION MUST BE LEVEL)
12" MINIMUM
CONCRETE FOUNDATION
TREADS ARE BEDDED IN CEMENT MORTAR WITH MORTAR JOINTS
BRICKS AT FRONT OF TREAD SHOULD ALWAYS BE FULL HEADERS
6" TO 8"
BRICKS AT FRONT OF TREAD SHOULD ALWAYS BE FULL HEADERS
12" THREAD, MINIMUM FOR ALL OUTSIDE STEPS
12" MINIMUM
CONCRETE FOUNDATION
6" TO 8"

Planning, estimating and foundations

FIRST OF ALL, especially if steps are to be a permanent part of your home, check your municipality's building department on local code requirements. It may stipulate, for instance, that steps must be tied to house foundation. Since steps are more complex than walls, it's best to make scale sketches so you can count the number of bricks needed—then add 5 percent for waste to your order. Foundations (footings) shown here and in other drawings are probably best left to professionals to pour, but you can make them yourself if you're willing to handle the complicated formwork involved.

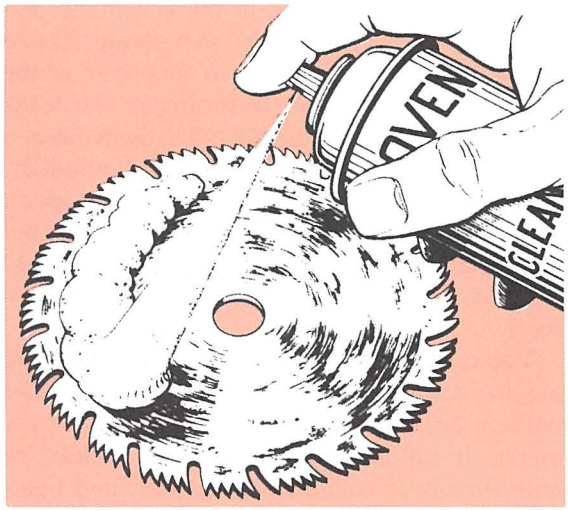
continued



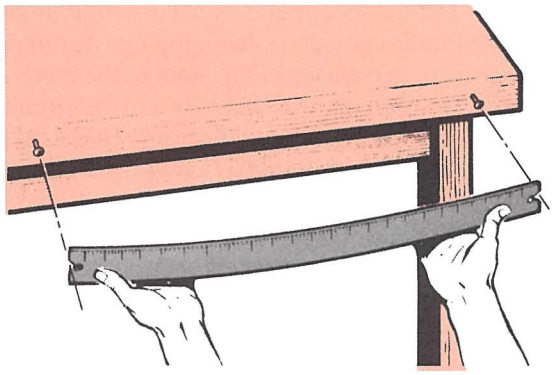
Formwork, pouring, finishing for concrete steps

FOOTINGS FOR CONCRETE steps should be below the area frost line and at least 8 in. thick. When the footing has set, a concrete-block foundation wall can be built up to grade with blocks mortared together and their cores filled with mortar. After the mortar has set (about 24 hours), backfill the soil around the wall, carefully tamping each 6-in. layer, until tamped backfill is at grade. The site is now ready for forms, which should be built as shown above with ¾-in. plywood for batter boards and 1-in. and 2-in. nominal stock for bracing. Forms must be well nailed and solid, so that pressure of concrete will not force them apart.

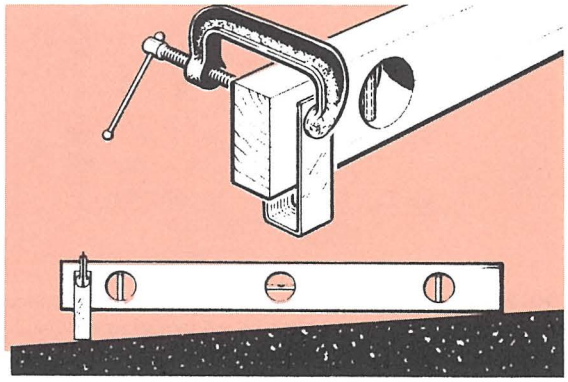
Since steps of this type require a large amount of concrete, you are well advised to use transit-mix (truck-mixed) concrete, pouring the steps monolithically (as a single unit); the stiffness of the mix should make it unnecessary to close in lower-step treads. You *can* hand-mix and pour one layer at a time, but this is not really worth the extra effort, as it raises the problem of tying the layers together. Estimate the amount of concrete needed by finding the volume of the steps in cubic feet and dividing by 27 to convert to cubic yards, and add 5 percent for waste. One cu. yd. is usually the minimum order for transit-mix concrete. Before pouring, give the inside of the forms a thin coat of form oil to keep concrete from adhering to wood. When the pour is complete, rap forms vigorously all over with a hammer; this helps the mix to settle and fill voids (honeycombs) that may occur next to the form boards. You should *not* pour if the temperature is below 40°F. or if it is raining. Use a wood float to finish the steps—a steel trowel would give too slick a surface. When concrete has set for at least 36 hours, carefully remove forms. Rough spots can be rubbed smooth with a carborundum stone and water. Fill any voids at this time with a cement-and-sand mix, troweled and rubbed smooth with the stone while still wet. To cure, keep steps moist and covered (to retain moisture) for five to seven days.



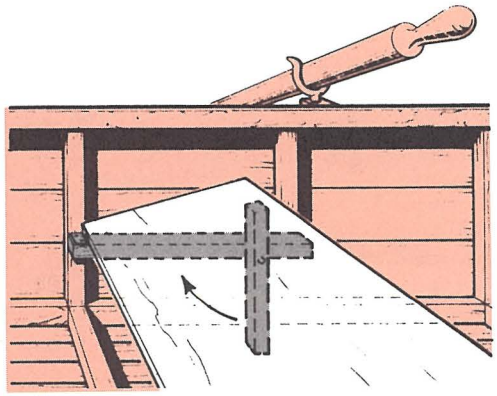
THE EASIEST WAY to remove pitch or gum deposits from your circular saw blades is to use oven cleaner. For better performance and appearance just apply a light coat of any spray oven cleaner and let it stand for a few minutes. Deposits can then be wiped off with a cloth. Turn the blade over and repeat the procedure to clean the other side.—*Robert S. Tupper.*



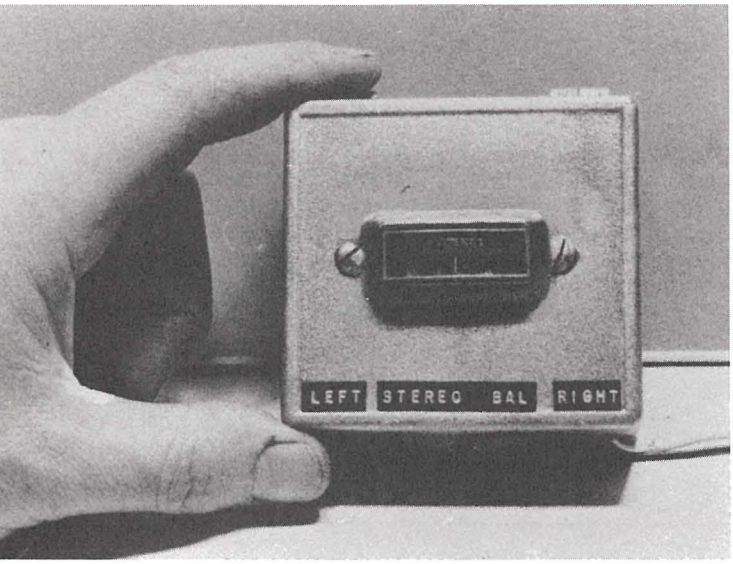
A YARDSTICK mounted on the edge of your workbench is a practical and timesaving addition. However, you can make it even more useful if you mount it so that it can be removed for use anywhere in the shop. Just cut keyhole slots in the ends and drive roundhead screws into the bench to engage the slots. To remove the yardstick, bend the ends inward to clear the screws.—*Wilfred Beaver.*



HERE'S A SIMPLE accessory for your level which will allow you to use it to check the drop when laying a sloping walk or driveway. Just bend a strip of sheet metal to form a U-shaped leg, making the slot wide enough for you to slip the level down between the two arms. Then set the level to the proper angle and secure the leg to the level with a C-clamp. This locks the angle, making the slope read "level."—*Wilfred Beaver.*



WHEN YOU'RE OUT in a rowboat and pulling hard against a strong current or wind, it's difficult to get much leverage because you are continually slipping forward on the seat. An easy way to get more pull per stroke is to elevate the forward edge of the seat. To do this, hinge the rear edge of the seat to the supporting cleats and install turnbutton supports beneath the forward edge. When not needed, these supports can be swung back to the horizontal position allowing the seat to rest on the cleats.—*G. E. Hendrickson.*



THE BALANCE METER and circuit components can be mounted in a handy plastic or aluminum chassis box.

Don't trust your ear— build a stereo balance meter

By HOMER L. DAVIDSON

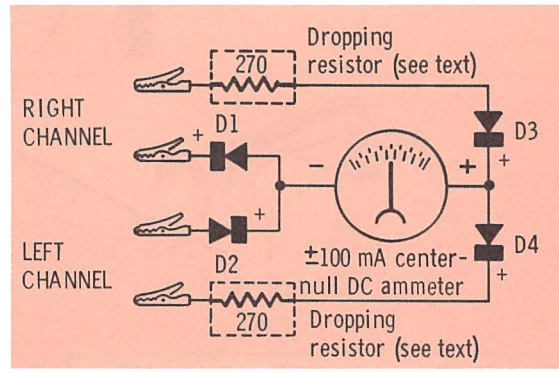
With a glance at the dial, you can adjust your stereo amplifier for perfect balance of left and right-channel volume level

■ LISTENING TO an out-of-balance stereo system is like having cotton in one ear. You can get the balance back, however, even if you *do* have cotton in one ear: Just build this stereo balance meter and let it do the "listening."

The heart of the balance meter is a 100-microampere, center-null d.c. ammeter. Diodes D1 through D4 are the least expensive diodes you can buy. As shown in the schematic diagram, the meter is connected to both the left and right channels of your stereo amplifier at the same time. It's easiest to terminate the leads with small alligator clips and attach them directly to the speaker output terminals on the amplifier. Equal signals will, in effect, cancel out and give a center null reading. Any imbalance in left and right-channel signal strength will cause this sensitive meter to deflect in the corresponding direction.

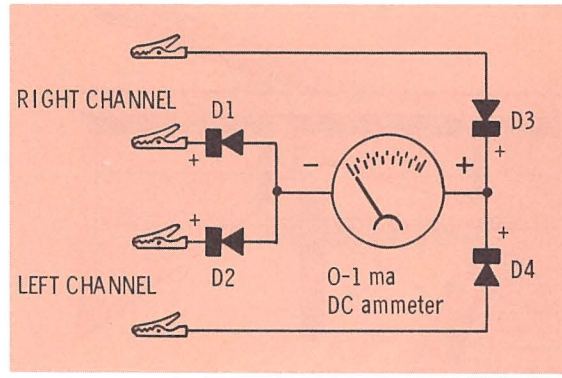
You can do a professional job of balancing by playing a stereo test record. Set your amplifier balance control for center scale and check the meter. It will confirm a balanced condition or indicate any imbalance between left and right-channel outputs.

When the balance meter is used with a large output of audio power, a dropping resistor may be necessary in each leg of the input to the meter. Select a 270-ohm resistor and wire it in the circuit as shown in the schematic diagram. Use a still larger resistor when amplifier power causes the meter pointer to exceed its deflection limits. You can use the meter with any stereo record player or radio whether tube-type or solid state.



THE SCHEMATIC DIAGRAM for the center-null balance meter shows polarity to observe when wiring diodes.

THIS SCHEMATIC DIAGRAM shows the diode polarities for the comparison-type balance meter circuit.



SEE ALSO

Cassette recorders . . . Cassette tapes . . . Electronics . . . Hi-fi centers . . . Speakers . . . Tape recorders

The meter and circuit can be mounted in a plastic box, as shown, or right into any type of stereo control panel or console you may have set up for your rig.

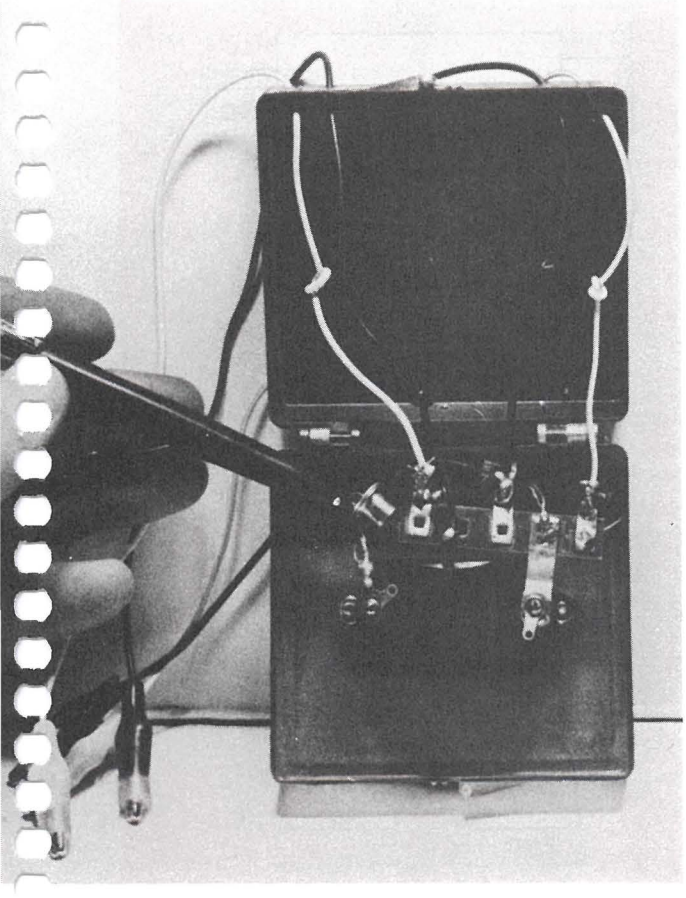
comparison balance meter

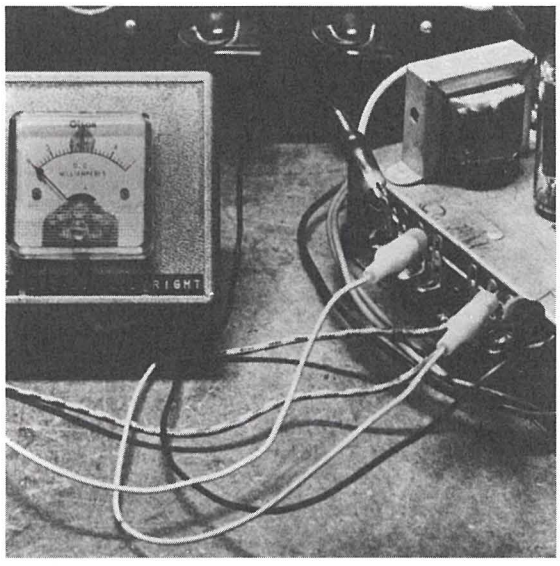
Another, alternate stereo balance meter can be constructed using a meter you may already have in your scrap parts box. If you have an 0-1 milliammeter around, it can be wired as a left and right-channel comparison meter. As shown in the schematic diagram, the two diodes in the left channel circuit are wired in reverse of their wiring in the balance meter circuit using the center-null meter.

Actually, with a comparison meter, only two silicon diodes are needed since you check each channel separately. By adding two additional diodes, the leads can be clipped to each channel and don't have to be switched from one channel to the other. Adjust the balance control so the same deflection is obtained for each channel.

A plastic box large enough to house the meter and circuit makes an inexpensive chassis for the project. If you don't have any handy, you can buy a small aluminum chassis box or improvise an installation in something else from workshop scrap.

A SIGNAL is passed to the meter from the silicon diode. The pointer shows the positive end of diode.





CHANNELS ARE CHECKED separately when the comparison-type meter is connected to the amplifier.

Drill holes in the box for the meter and the test leads. Rather than use expensive jacks and plugs for the leads, solder them directly to a four-lug terminal strip which can be mounted on the meter terminal screws, and use strain-relief knots in leading them out of the chassis box. Then just solder the diodes in place on the terminal strip and the job's done.

Check over your wiring to be sure that polarity of the diodes is correct. With "top hat" diodes, the metal flanged end is the positive end and the negative end has the insulated lead. With tubulartype diodes or those of other configurations, the positive end will always be marked with either a positive sign or a band.

PARTS LIST

Center-null stereo balance meter

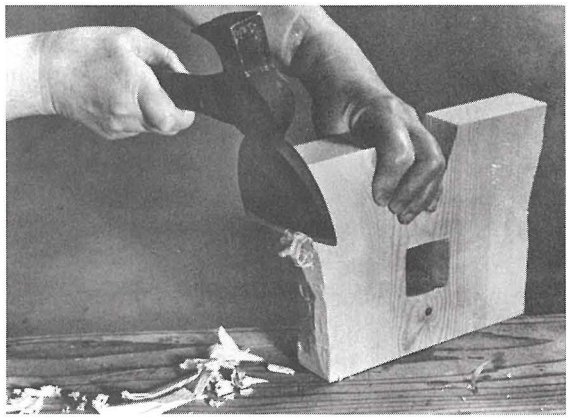
M—100-*u*a center-null balance and tuning meter (Lafayette 99R50262 or equiv.)
D1 through D4—Silicon diodes (1N34, 1N34A, 1N46, 1N48, 1N51, 1N60 or equiv.) (Package of 10: Lafayette Radio 32R08774)
Resistors—Two optional 270-ohm or larger ½-watt fixed carbon resistors (see text)
Misc.—Chassis box, terminal strip, test leads, alligator clips, panel markings, solder

Comparison-type stereo balance meter

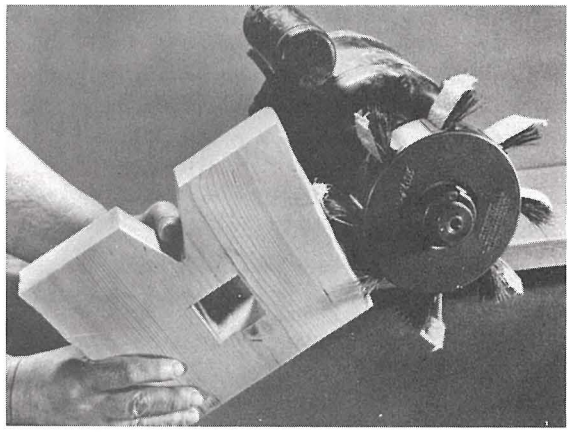
M—0-1 ma. (Lafayette 99R51070 or equiv.)
D1 through D4—Same as above.
Misc.—Same as above.

Rustic slab stool

By ELMA and WILLARD WALTNER



HAND-HEWN LOOK is produced by lightly chopping edges of the legs and top with a hatchet, then sanding.



LIGHT SANDING with a flap abrasive wheel gives a worn look to "adzed" edges. It can be done by hand.

SEE ALSO

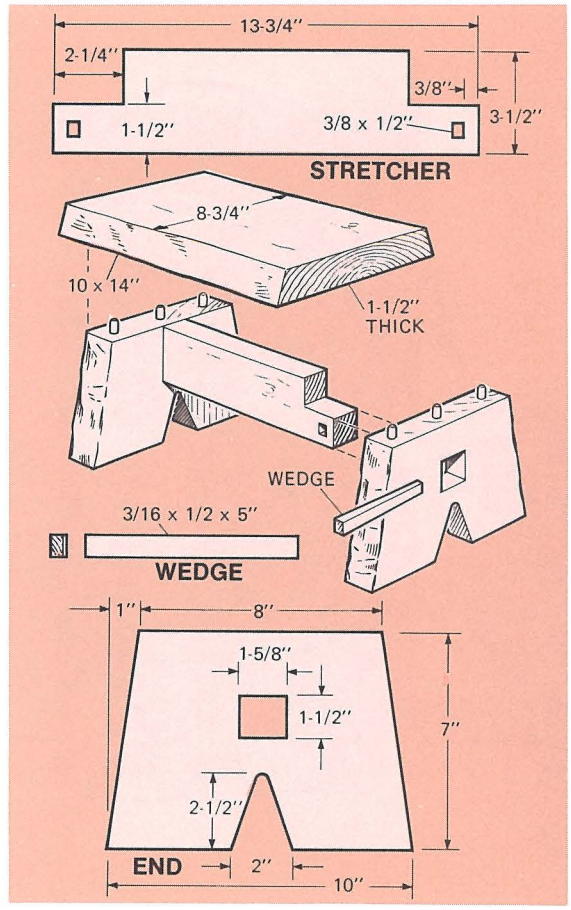
Footstools . . . Gifts, Christmas . . . Log projects

THIS ROUGH-HEWN STOOL will be right at home in an early American setting. It's made of 2-in. pine (actually 1⅝ in.) and assembled without nails or screws.

Rough-carving the edges of the top and legs with a hatchet gives the stool rustic look. To save time, saw the legs to shape; then chop them for texture. Work from bottom to top to avoid splitting. Finish by lightly sanding the burrs that are left from chopping.

Notice that the wedge slots in the stretcher extend into the leg openings so that the pegs draw the stretcher tight. The pegs should taper slightly from end to end.

Give the stool a coat of natural wood filler, followed by two coats of fruitwood stain. Then apply a coat of clear satin finish, sand lightly and rub with a cloth to give the stool a well-used look.



Ministool

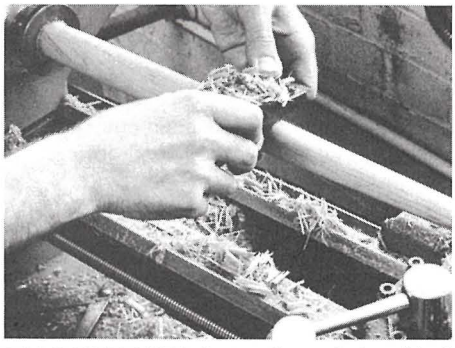
Make a pair of these ministools and amaze yourself with the many uses you'll find for them

By KENNETH WELLS

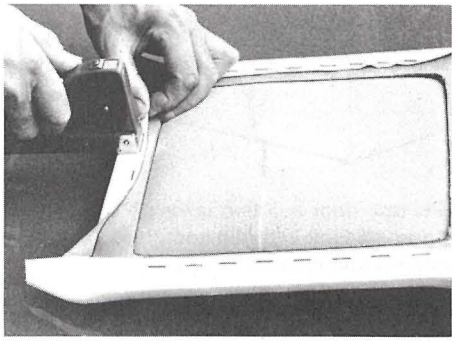
WHAT COULD BE HANDIER than a pair of these little padded stools? Being higher than the average chair, they'll be just right for preschoolers to sit up to the table at mealtime, and guests will find them better than the floor when seating runs short.

The drawing shows how simple it is to make one. You'll need a lathe to turn the legs and rung, but if you don't have one, you can substitute regular tapered legs bought in a store and use a plain dowel for the rung. Here the threaded stud is removed from the end of each leg and a tenon is hand-fashioned to fit a 1-in. hole. Holes for the legs are drilled at a slight angle to splay them. Glue is used in addition to wedges to lock the legs in place, after which the tenons are sanded flush. The seat frame is padded with foam rubber and covered with vinyl.

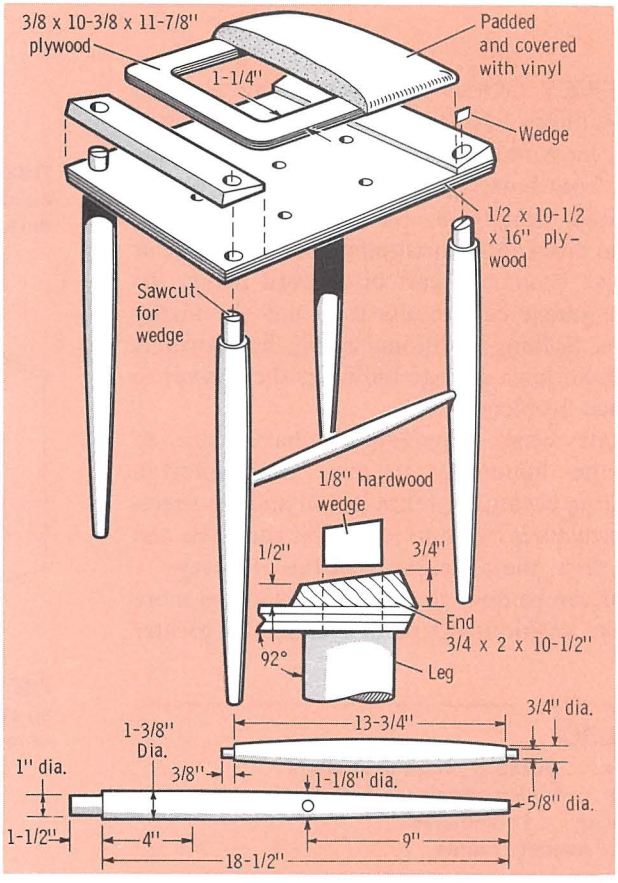
SEE ALSO
Footstools . . . Legs, furniture



A BLOCK PLANE is better than a lathe chisel for turning sections of the legs.



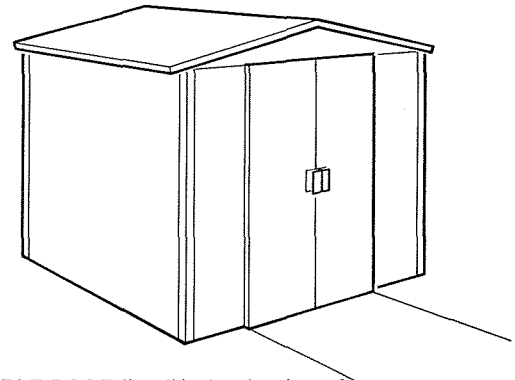
VINYL COVER is stapled to the bottom of padded seat. Screws attach the seat.



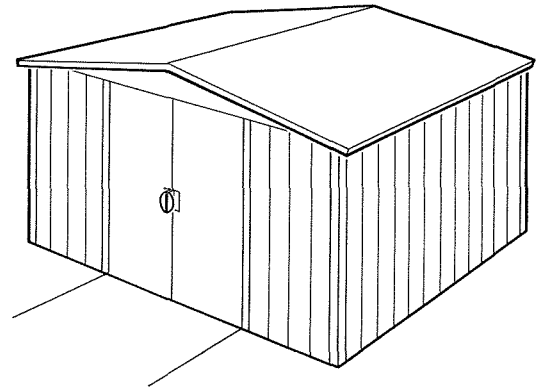
Clever designs for storage buildings

By WAYNE C. LECKEY

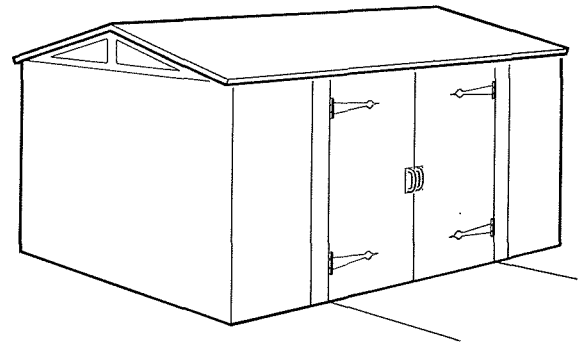
Even the best of sheet-metal sheds begin to get pretty beat-up after the weather takes its toll. Here are three different ways you can make them more attractive



A GABLE-ROOF "box" is the simplest of storage buildings, but benches, trellises, a cupola and roof extensions dress it up.



THIS TYPICAL unit is relieved of its plain out-building look by clever addition of a kid's lookout deck erected over the roof.



THE COMMON side-door building takes on an attractive pergola look with the addition of rafters, benches and climbing vines.

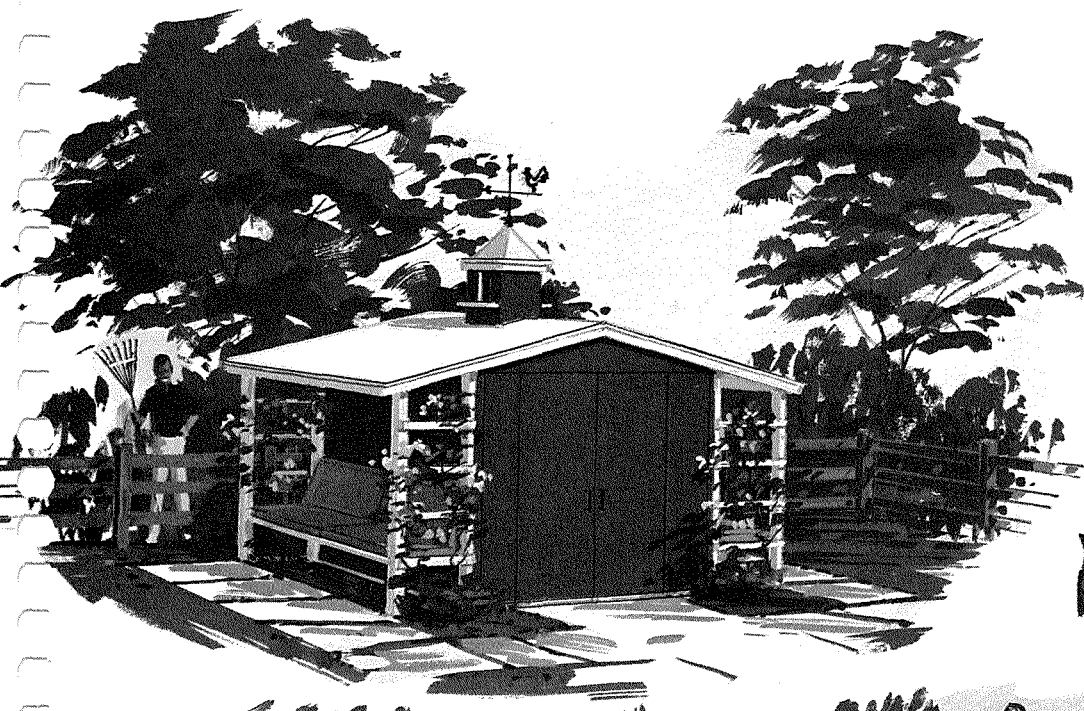
THERE'S GOOD REASON why outdoor lawn buildings have become so popular—homeowners have found them necessary to keep the garage from bursting at the seams. With all the yardpower equipment, the snow blower, kids' toys and bikes and a hundred and one other items that have become a part of modern living, the average garage can't house it all and the family car, too. Seeking additional room, homeowners have found lawn storage buildings the answer to the space problem.

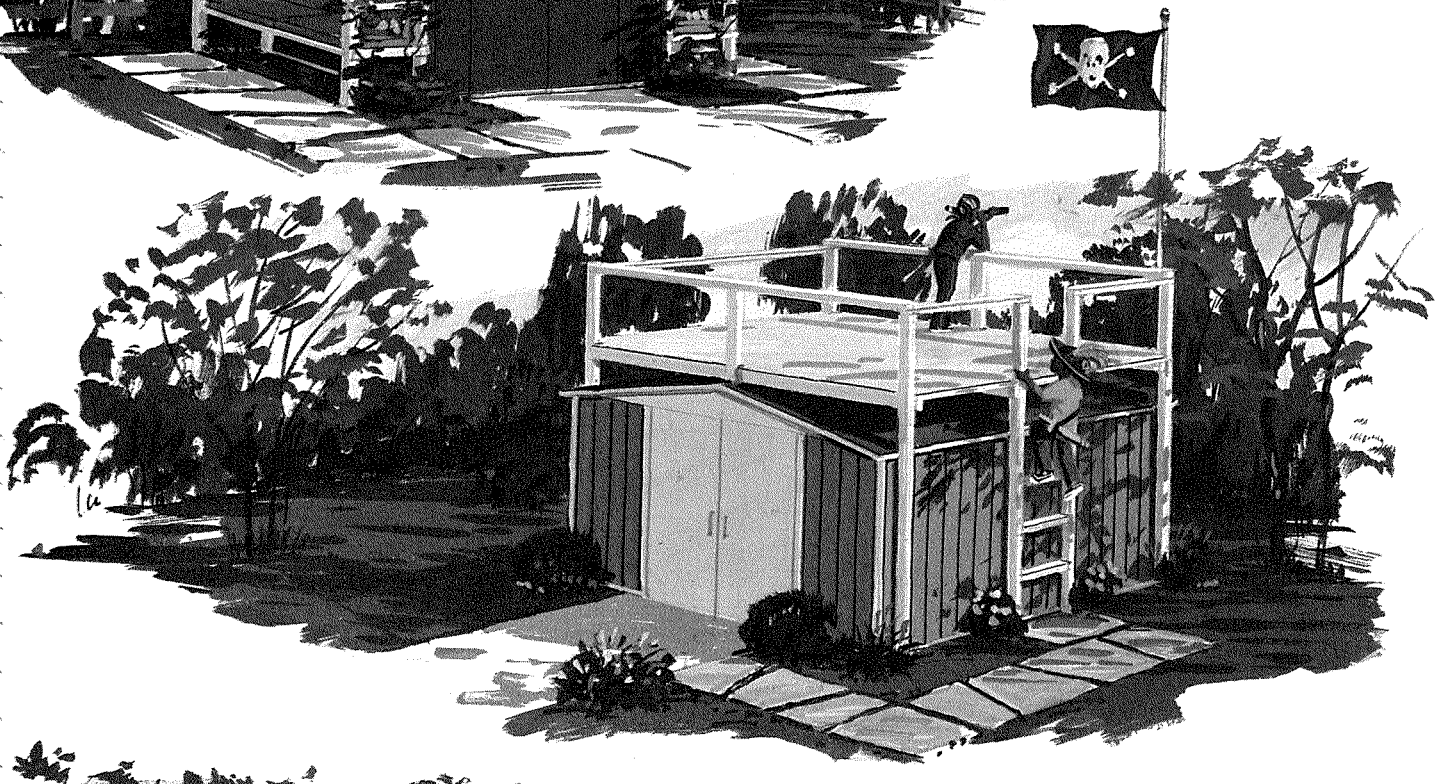
Despite what manufacturers have done to make the buildings attractive and colorful, weathering eventually takes its toll and the sheet-metal structures begin to look a bit rundown and detract from the appearance of the property.

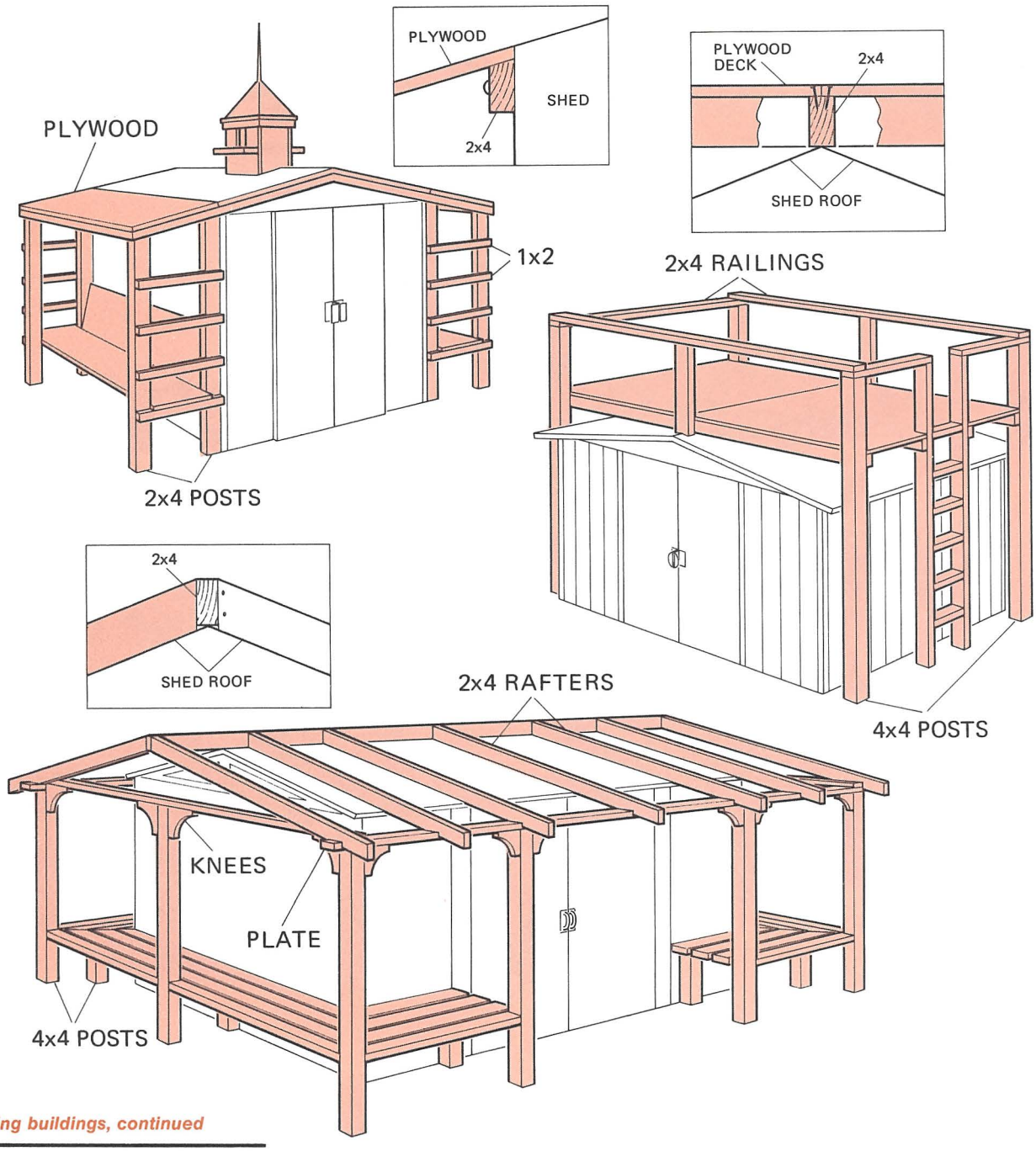
What can be done to make the buildings more attractive additions to a yard, even serve a greater

SEE ALSO

Cabanas . . . Decks . . . Garden shelters . . . Gazebos . . . House additions . . . Patios . . . Playhouses . . . Poolhouses . . . Screened summer rooms







disguising buildings, continued

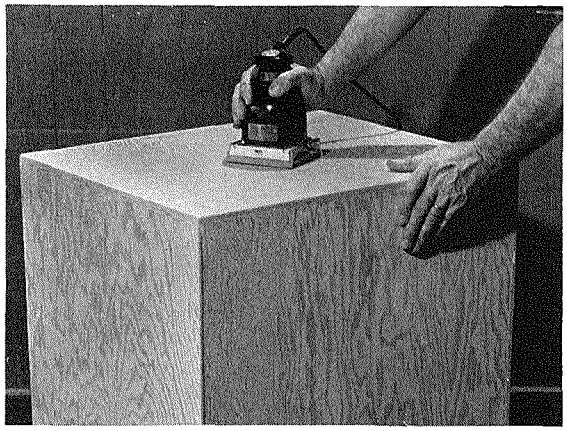
need? We tossed the assignment at Carl Sigman, a designer well known for his home face-lifting ideas, and asked that he take three of the more popular styles which are available and let us see what could be done to relieve their plain look at minimum expense.

The three designs you see here show what can be done to make such structures more attractive. One of the designs adds a pergola look, another provides a "tree house" for the kids. (For added safety, particularly for younger children, you may want to install an intermediate rail and a kickboard). All three are good examples of what a bit of face-lifting will do.

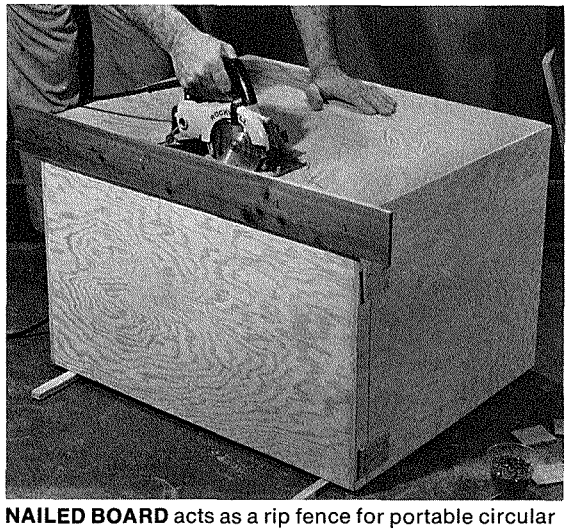
Each transformation makes use of common lumberyard members—2x4s and 4x4s, combined with sheets of exterior plywood. All members are treated with a wood preservative, and either stained or painted a matching or contrasting color.

How to fit a lid to a chest

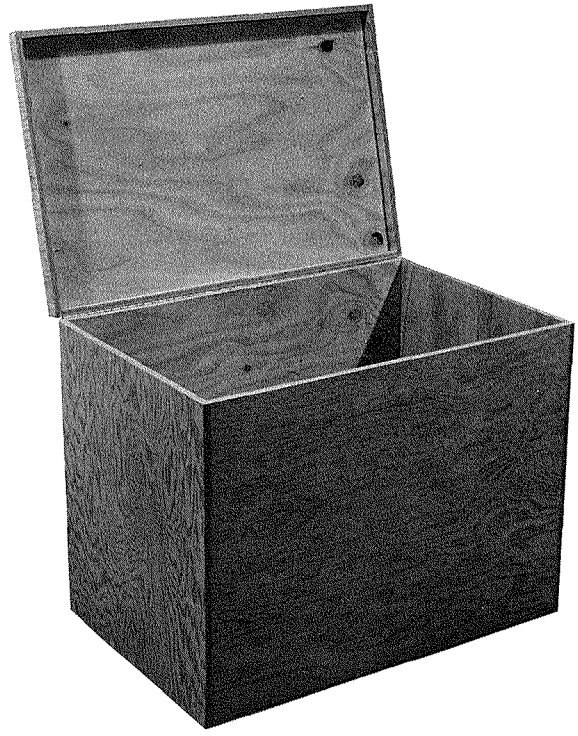
By JOHNNY POWELL



AFTER BOX is constructed, nails are set or screws countersunk, holes filled and all surfaces sanded.



NAILED BOARD acts as a rip fence for portable circular saw. Use a hollow-ground combination blade to cut lid.



LID FITS this box perfectly because—as the woodworking pros do—the box was built as a fully enclosed unit, then the top section was cut off for a lid.

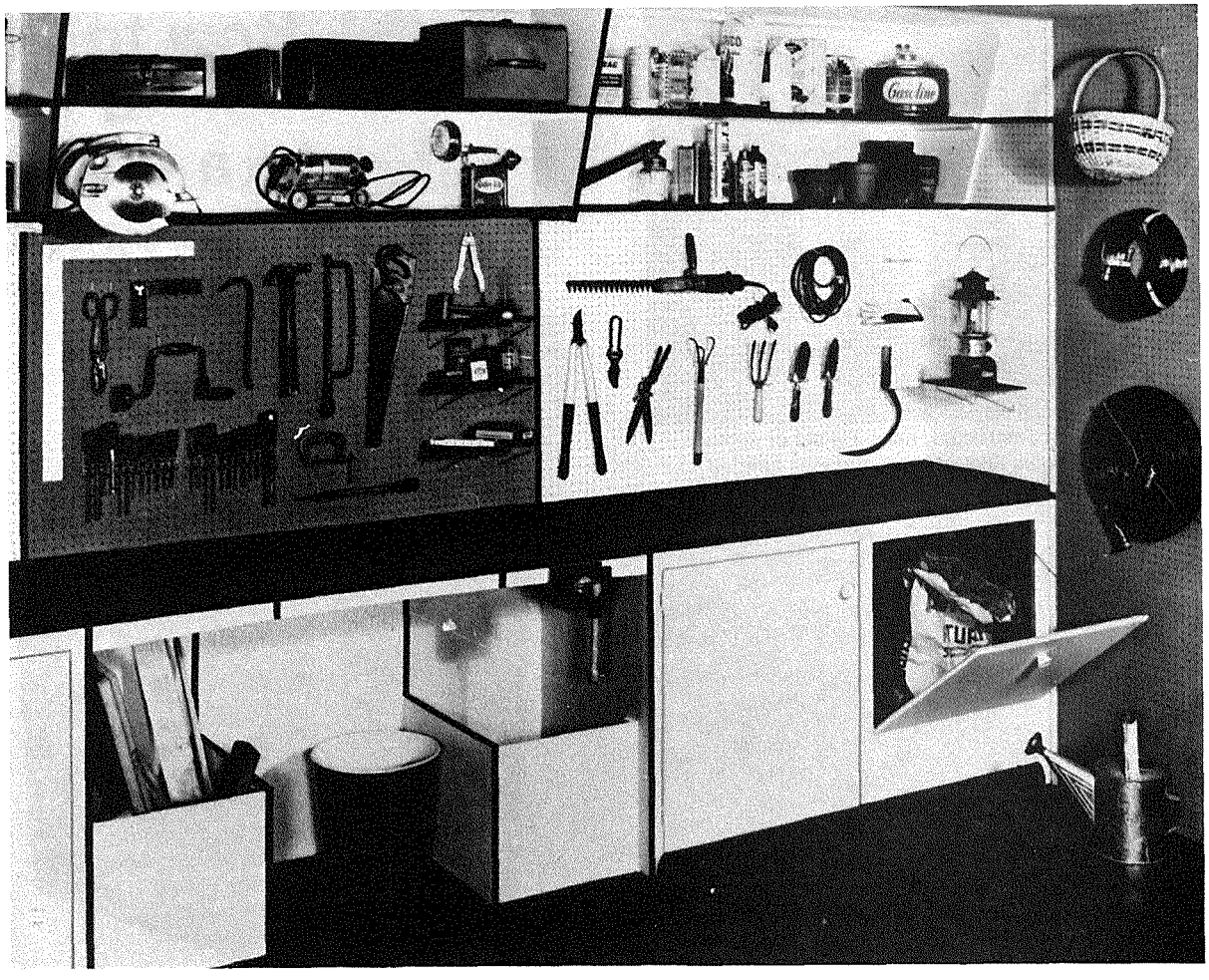
■ THERE'S ONLY one way to make a lid for a box that fits the box perfectly. As experienced workshoppers know, any box can have a perfectly mated cover by first constructing the box as a fully enclosed unit and then cutting off the top.

Shown above is a fairly large storage chest. However, no matter what size box you build, the construction principles are the same. First assemble the closed box, using glue and nails or screws. If necessary, use diagonal braces to keep the box square and true while glue dries overnight. Nail or screw size will depend on the thickness of the material. (The general rule is to use a nail or screw three times longer than thickness of the stock being fastened.) *Caution:* Do not nail or screw along the line where you will be cutting off the lid. Sand the box thoroughly.

For a small box, the lid can be cut off with four passes on a bench saw. For a larger box, such as that shown, a portable circular saw with a smooth cutting blade (fine-tooth plywood or hollow-ground combination) should be used. For a saw guide, nail a straight board along the edge to be cut, allowing it to project above the edge slightly. With the saw set to a depth of cut that will penetrate the full thickness of the stock, make the first cut. To prevent shifting, nail two small cleats over the kerf using four small brads with each cleat. Relocate the guide strip and make the remaining three cuts, cleating each kerf as before.

SEE ALSO

Chests . . . Circular saws, portable . . . Sanding . . . Storage ideas . . . Workshops



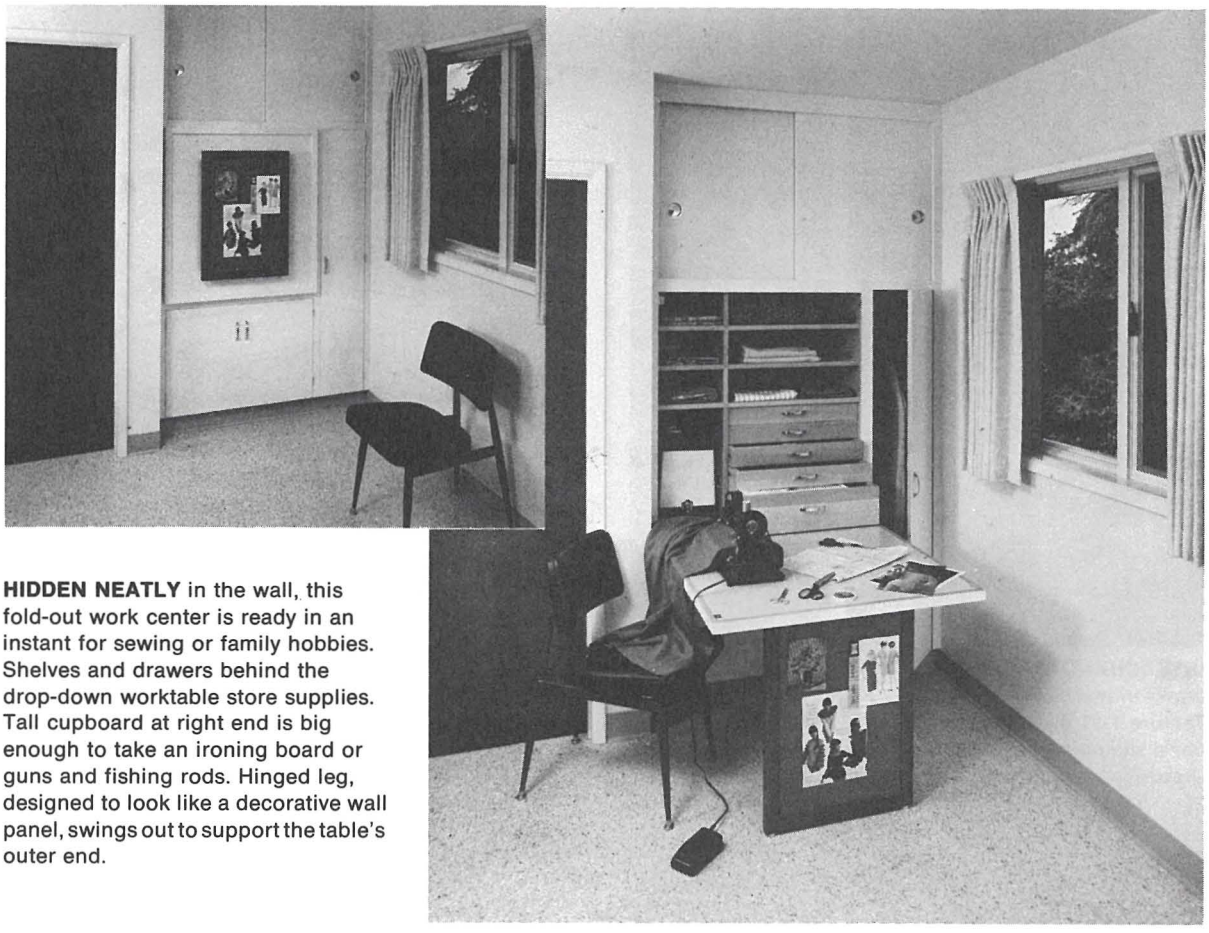
GARAGE-WALL storage unit is a double-duty built-in that provides both work and storage space. It doesn't take as much space as it looks, and can be made to take only two feet off the end of a garage. The long workbench is especially handy for car and yard-tool fix-it jobs that require a long layout area. There's a great deal of storage space both above and below.

Great ideas for finding storage space

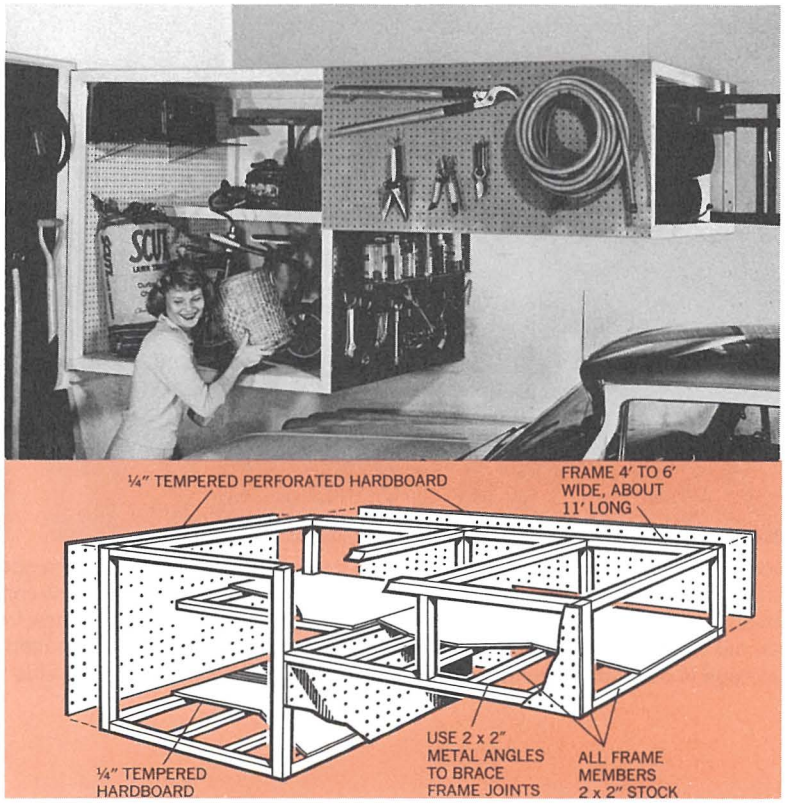
Looking for more storage space? Today, the answer isn't just another trunk in the attic. In the modern equipment-packed home, you need to hide things away and still have them at your fingertips, ready for instant use. There's the movie projector, the hi-fi rig, your prized fishing, hunting and photographic gear, countless tools and toys, games and hobby supplies, skis and tennis rackets and baseball bats, kitchen and laundry appliances, a model train or road-race set—all must have their place yet be kept handy if you're going to use and enjoy them. On these pages you will find a number of clever ideas for versatile, space-saving storage arrangements that can make living more efficient and fun

SEE ALSO

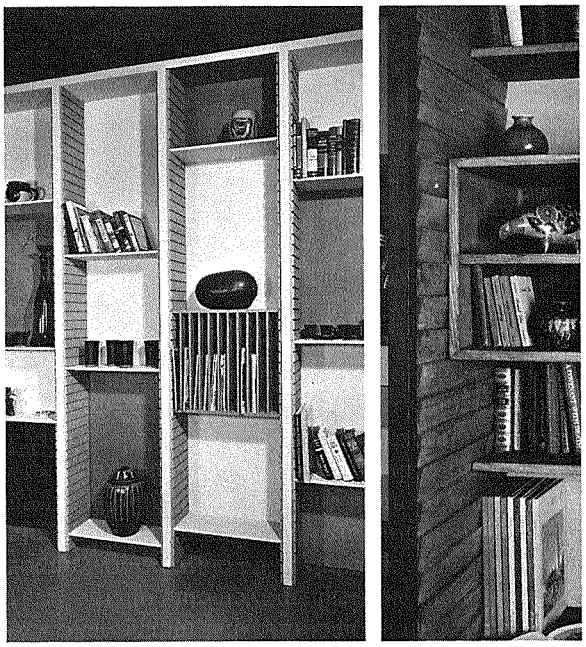
**Appliance centers . . . Closets . . .
Garage remodeling . . . Hi-fi centers . . .
Hobby centers . . . Kitchens . . . Laundry counters . . .
Privacy screens . . . Room dividers . . .
Storage walls . . . Study centers . . . Theaters, home**

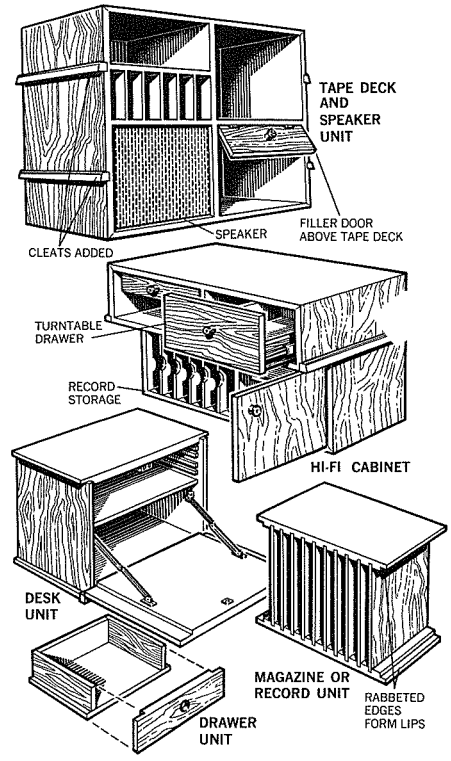


HIDDEN NEATLY in the wall, this fold-out work center is ready in an instant for sewing or family hobbies. Shelves and drawers behind the drop-down worktable store supplies. Tall cupboard at right end is big enough to take an ironing board or guns and fishing rods. Hinged leg, designed to look like a decorative wall panel, swings out to support the table's outer end.

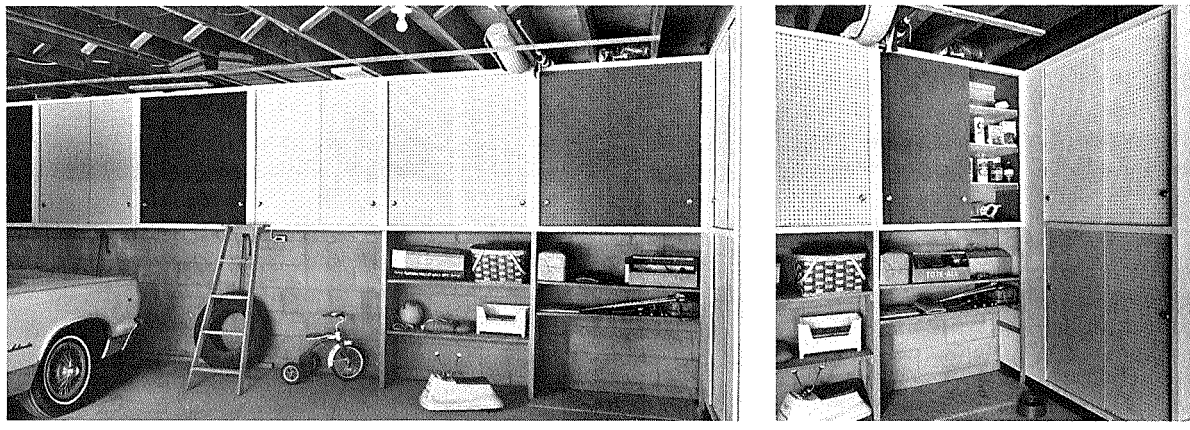

¼" TEMPERED PERFORATED HARDBOARD
FRAME 4' TO 6' WIDE, ABOUT 11' LONG
¼" TEMPERED HARDBOARD
USE 2 x 2" METAL ANGLES TO BRACE FRAME JOINTS
ALL FRAME MEMBERS 2 x 2" STOCK

DESIGNED TO HANG over the hood of a car, this L-shaped storage unit takes advantage of normally wasted garage space. It's perfect for garden supplies, extra tires, folding patio chairs and similar items. Side panels of Masonite perforated hardboard (Pegboard) provide additional space on the outside for hanging tools. If ceiling is low enough, you can fasten the unit directly to it. If not, suspend the outer end on chains or cables anchored to the ceiling with screw hooks. Inner end of unit is fastened to wall, either with screws into studs or expansion anchors into masonry.

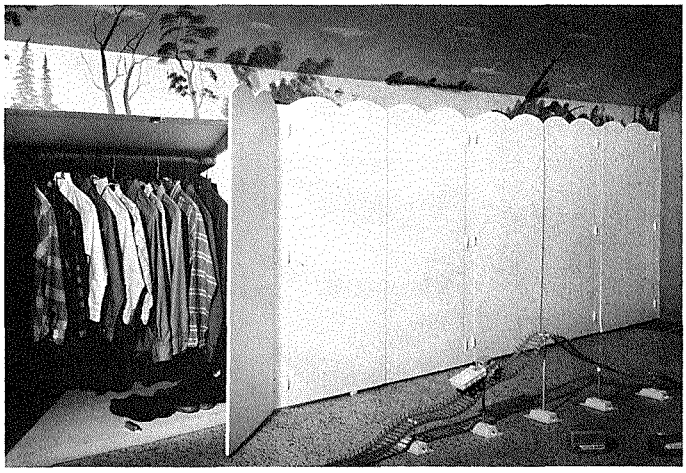


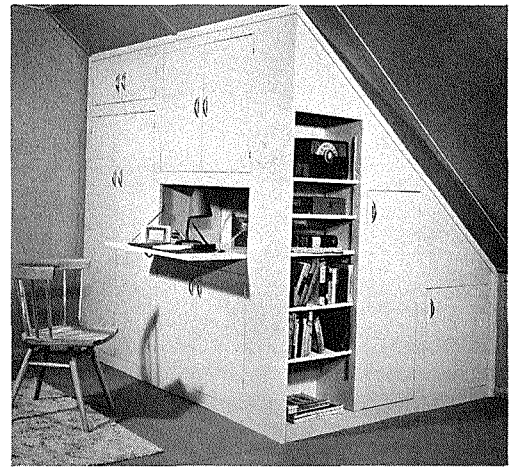


INTERCHANGEABLE STORAGE units slide in and out on tracks in two clever walls above. At left, strips of grooved Texture 1-11 plywood provide ready-made slots. Right, bevel sliding nailed upside down forms support ledges. Drawings show units that can be built to slide into place.



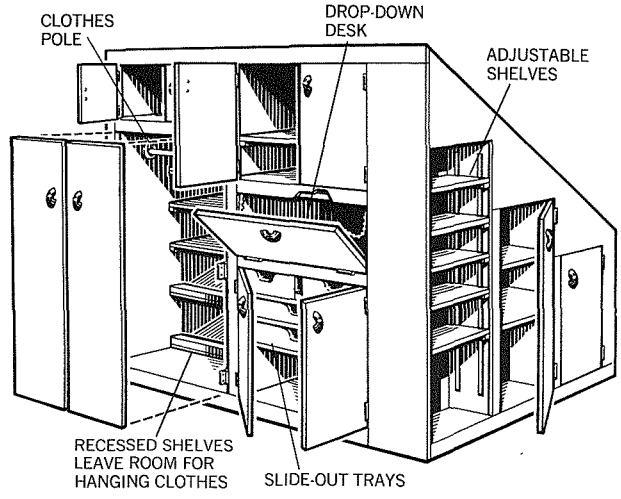
HIGH OFF the floor, wall-hung cupboards don't block car, leave parking space underneath for bikes and other bulky gear. Each 3-foot-wide section is a different color for handsome appearance. Doors of perforated hardboard cost little and help to provide needed ventilation to prevent any mildew from forming inside. The front half of an old stepladder rested against the cabinets is especially handy for reaching the upper shelves. If even more storage is desired, full-length cabinets (right) can be added to line the side walls of the garage.

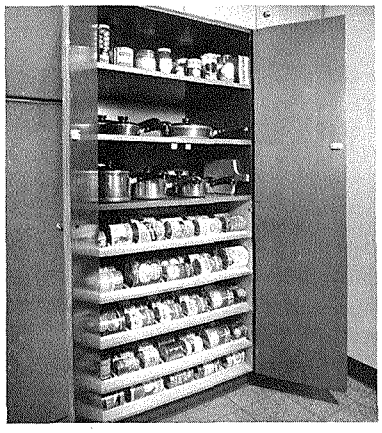


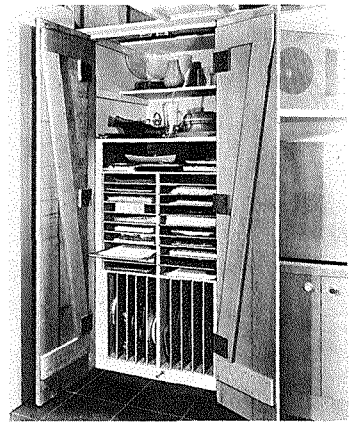


LOW-HEADROOM NOOKS under the eaves can be put to good use for storage. Scallop-topped "fence" at left, above conceals a row of shelves and clothes poles. Leaving the top part open to the ceiling makes the room seem larger than if it were closed in. Tree branches painted on the wall behind give illusion of a distant garden scene to increase the feeling of space.

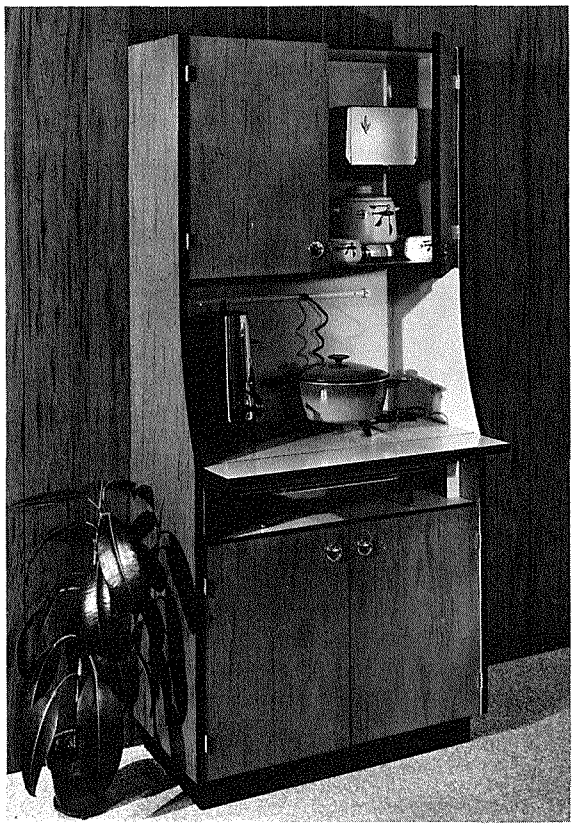
SLOPING BUILT-IN at right packs a lot of storage in a little space, even has a drop-down desk. Side doors give access to rear compartments.

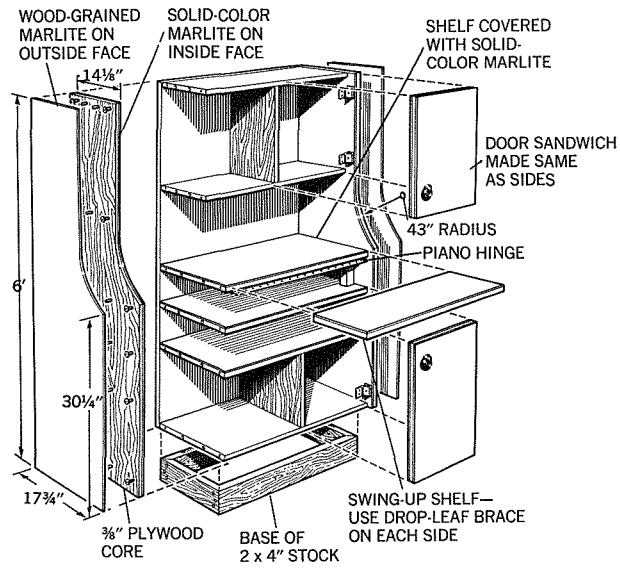




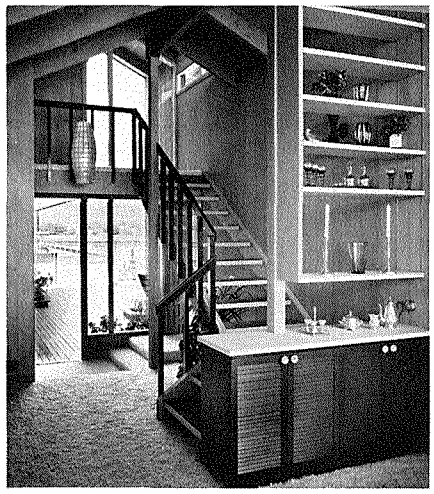


SLANTED SHELVES in cupboard at left work like supermarket racks. Cans, stored on their sides, roll conveniently down to you as you lift the front ones out. In the center photo, shallow shelves are used in place of conventional overhead cabinets. Cans and jars are easy to see and can be reached without necessity of removing the items from the front to get at those in back. In the cupboard at right, closely spaced shelves and vertical dividers keep thin objects such as trays, platters and flat pans neatly sorted.

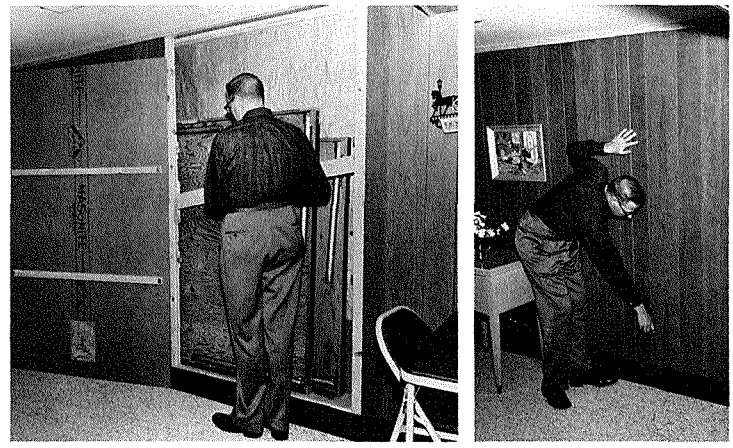




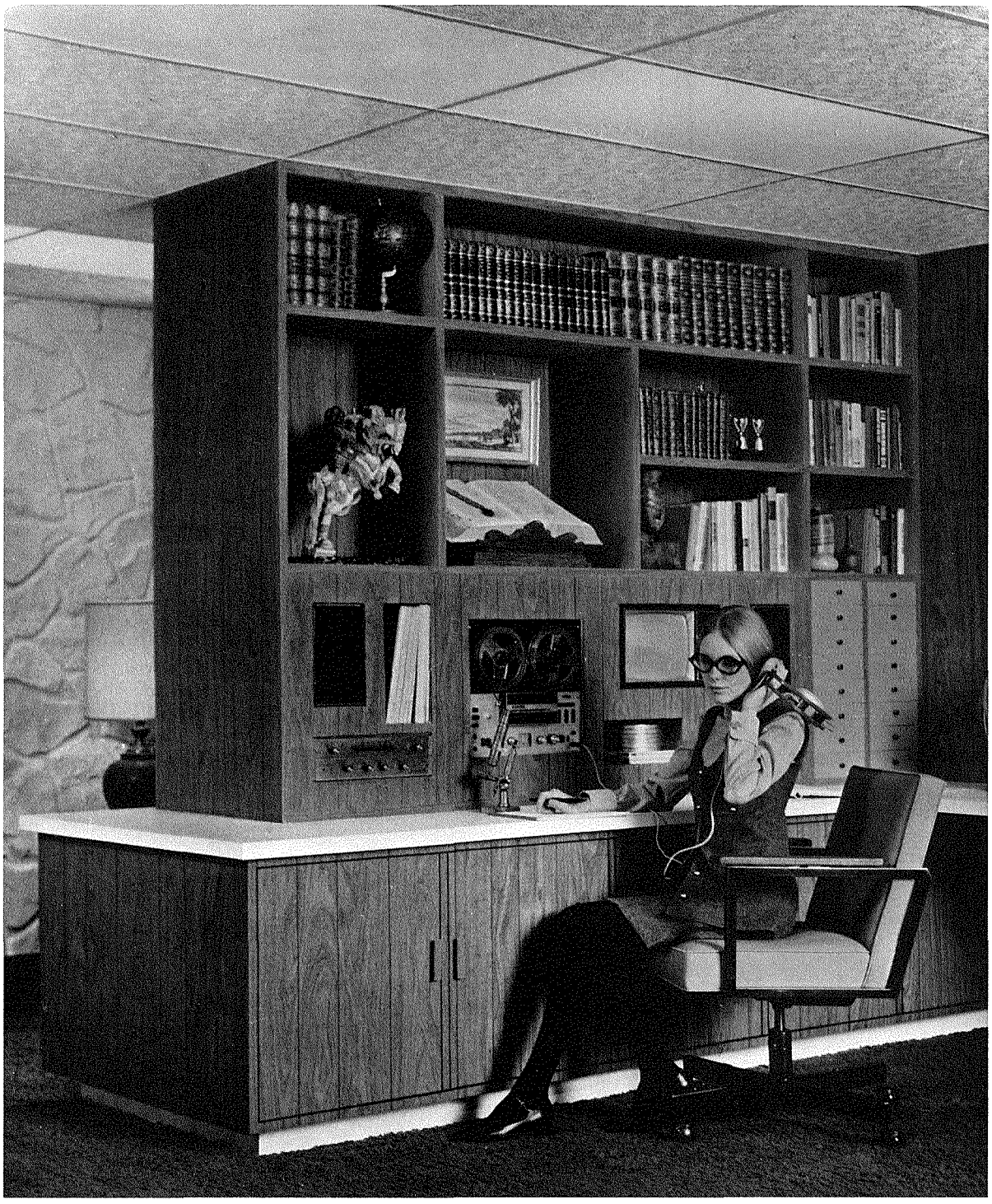
THIS MODERN HUTCH stores appliances and lets you use them at the same time. Outlets at the back enable you to keep toaster, percolator, food blender and other electrical appliances plugged in, ready for use. A hinged panel swings up to form a serving counter. Doors and sides are a clever sandwich of ⅜-in. plywood with two kinds of Marlite paneling cemented to it—wood grained outside, solid color inside.



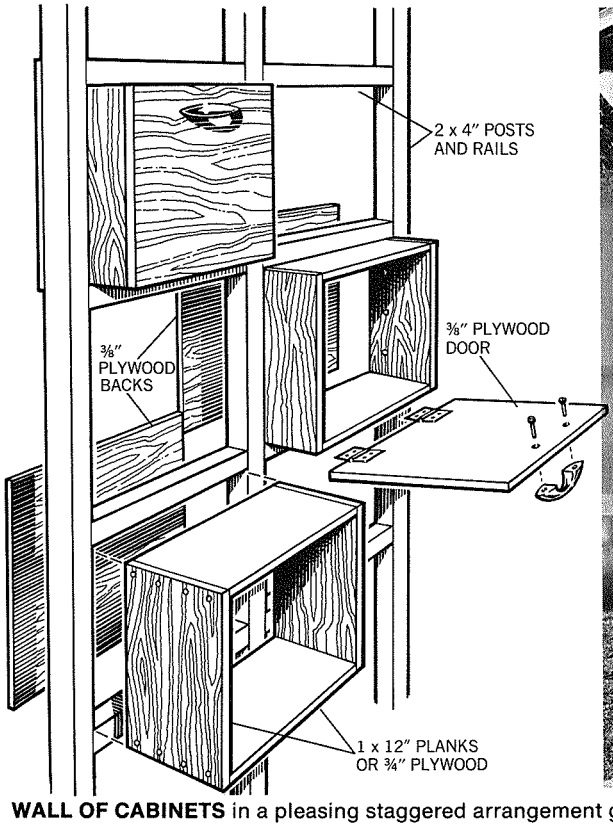
STORAGE CAN BE handsome as well as functional. These open shelves at the foot of a stairway display decorative objects, while the larger base cabinet conceals less-showy items behind louvered doors. Such a unit not only adds storage space, but can also serve as an attractive room divider, in this case helping to screen off the stairway from a dining room.

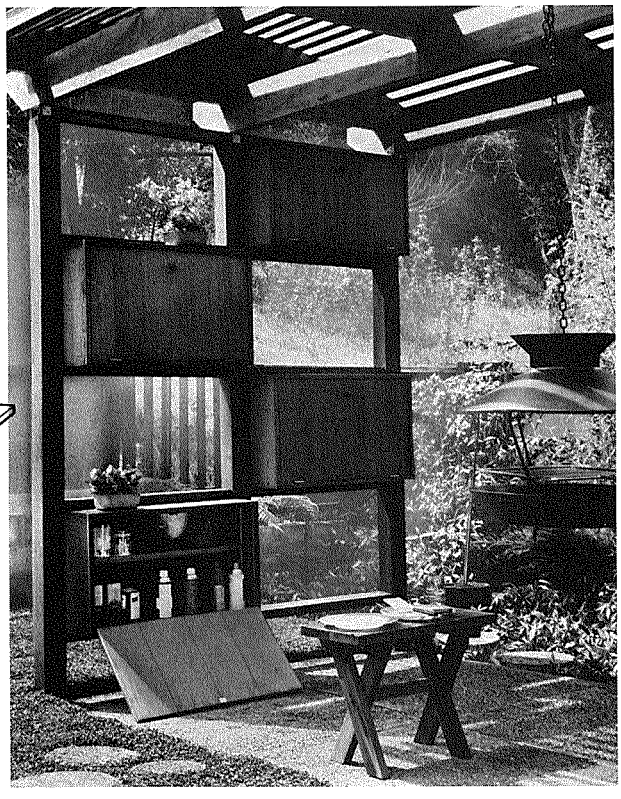


HOLLOW SPACES behind false walls can hide hard-to-store items like the table tennis table at left, above. If you're paneling a wall, especially in a basement, it's often a good idea to locate your framing so it leaves a few inches between it and the old wall. This will provide room for recessed shelves, built-in hi-fi equipment or storage compartments such as the one here. In the wall shown, one four-foot-wide sheet of hardboard paneling is removable, creating a big opening so the table can easily be slipped in and out. Magnetized catches hold the paneling so there's nothing to show from the outside.

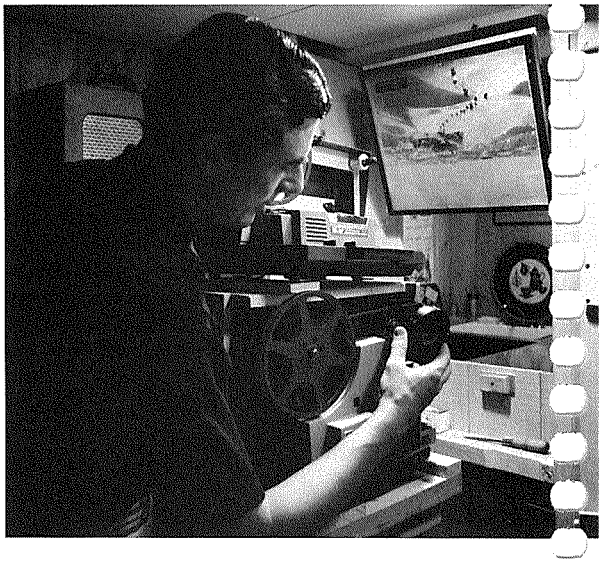


MULTIPURPOSE BUILT-IN is room divider, storage wall, hi-fi center and worktable all rolled into one. Front panels house a tape deck, amplifier, stereo speakers and a TV set. Surrounding counter adds workspace for editing tapes, doing school homework and similar chores. Wood-grained panels give wall a handsome appearance.

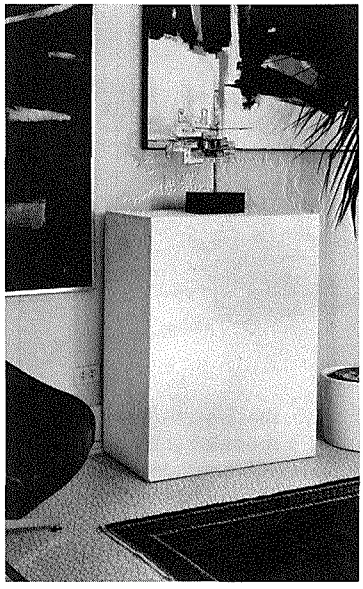


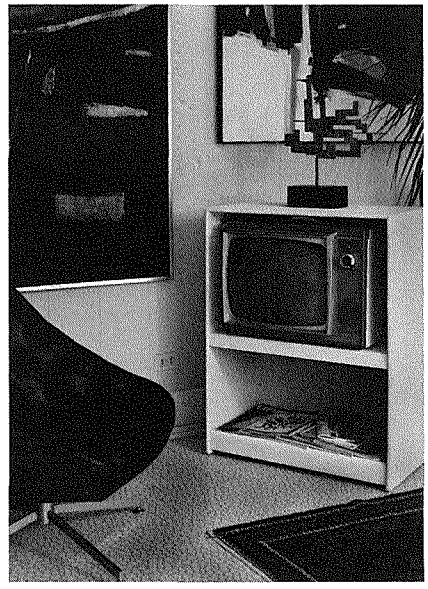


WALL OF CABINETS in a pleasing staggered arrangement gives shade and privacy and at the same time stores garden supplies, barbecue utensils and other outdoor items. Cabinets can be built under an existing structure, such as along the open side of a carport or porch, or they can be part of a garden shelter, as here. If the wall is load bearing, use four-by-four posts instead of two-by-fours shown in the drawing. Note that backs of cabinets are extended to overlap posts and cross rails. This adds extra bracing and helps to strengthen the wall. Redwood is a good choice for this type of unit.

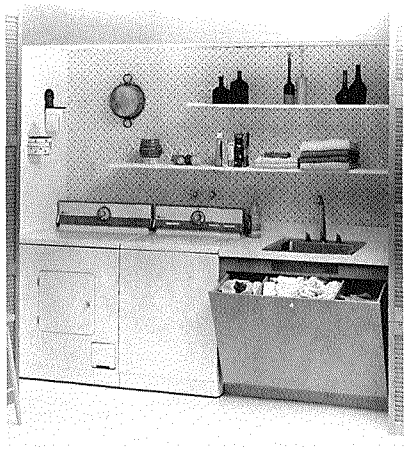


MINIATURE PROJECTION BOOTH—actually an unused cellar alcove closed in with pine paneling—not only stores photo equipment out of the way, but lets you leave it set up for quick use. Swiveling projector platform holds a Kodak Instamatic Super-8 machine alongside a 16-mm model so either can be run without disturbing the other. A slide and movie projector could be paired in the same way. Left-hand photo on opposite page shows projection window and smaller viewing port for operator to see. The screen is mounted behind doors at the far end of the cellar (photo, far right).

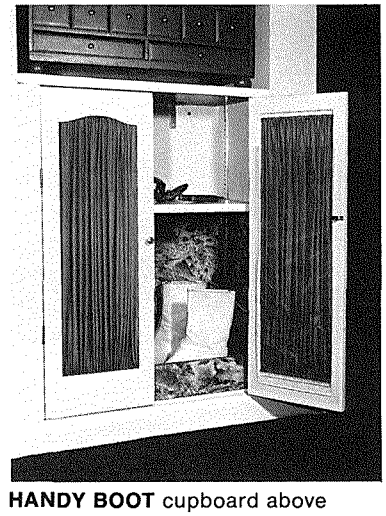




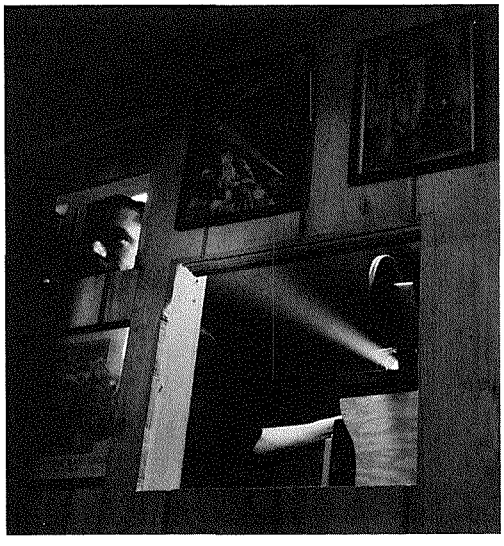
MOUNTED ON casters, this mobile cart for a TV set can be turned to give best viewing angle, depending on where the viewers are seated, or even rolled from room to room. When not in use, TV can be turned to face the wall, as at far left, to conceal its blank screen. Casters, mounted underneath a recessed bottom, are fixed in front and swivel at back for easy maneuvering. The cart is made of plywood and covered with painted burlap.

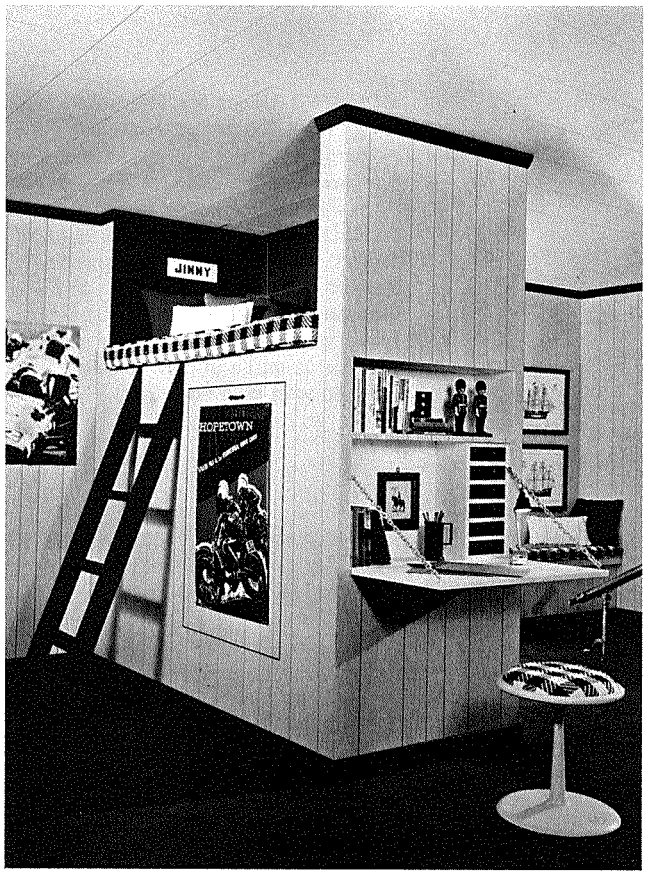


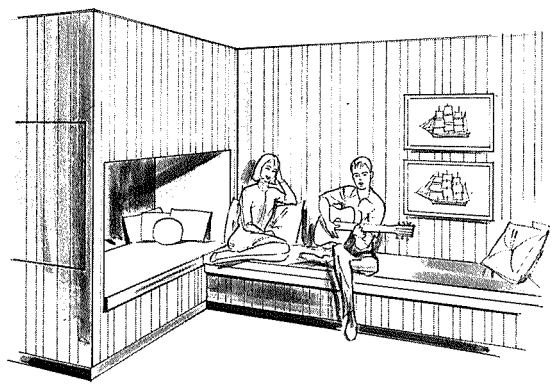
HOME LAUNDRY center like one at left designed by Maytag combines washer and dryer with shelves and a work counter for easing washday chores and storing supplies attractively. Wall of perforated hardboard at back supports shelf brackets and other hook-in fixtures. Three-section tilt-out bin under counter makes it easy to sort soiled clothes.



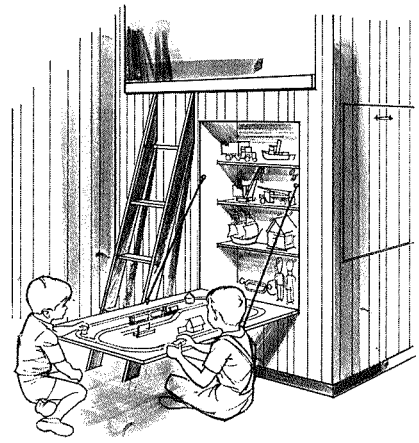
HANDY BOOT cupboard above keeps wet and muddy overshoes out of sight, lets them drain harmlessly into bottom drip pan. Boots rest on a slide-out rack of perforated hardboard. A removable baking tin below catches drips.



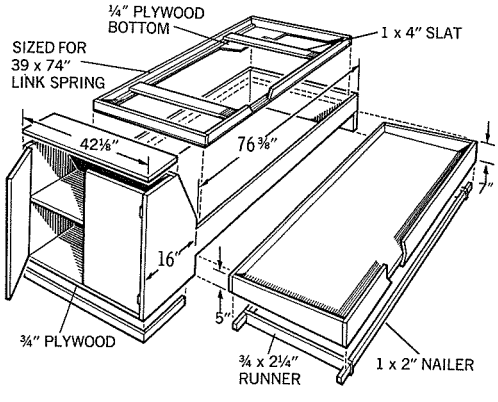


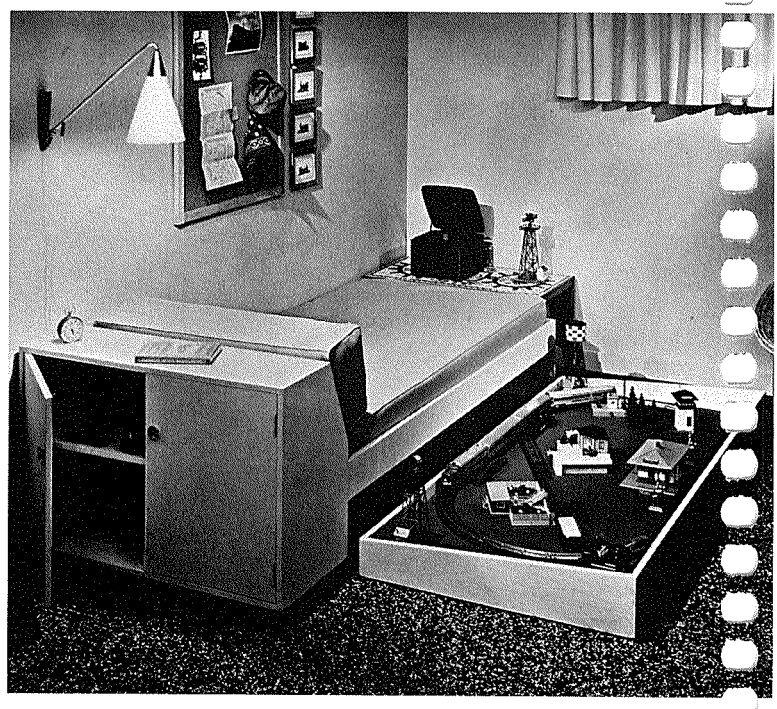


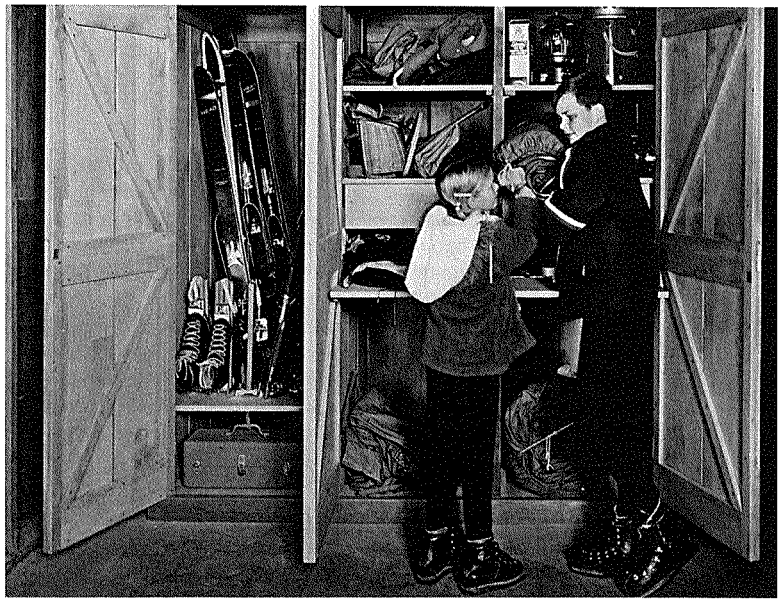
FACING OPPOSITE ways, these over-under bunkbeds help to divide a room for youngsters of different ages and interests. On one side, lower bunk doubles as couch when area is used for teenage get-togethers. On other side, a train board drops down. Study desk swings out from the end. Celotex V-grooved panels cover bunks.



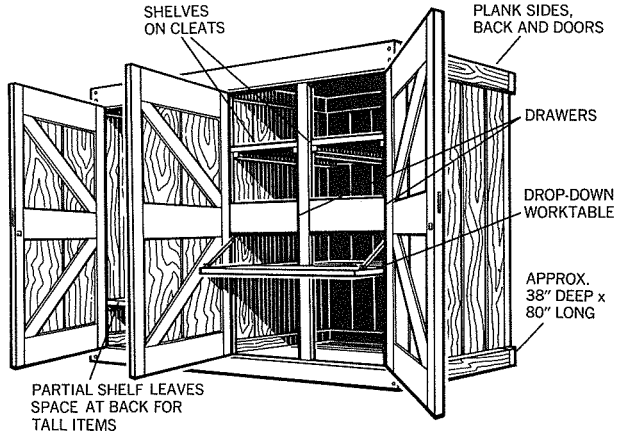
SLIDE-OUT TRAIN board goes to bed along with its owner, storing neatly away underneath. Its sloping design lets it fill the opening under the bed when pushed in for a trim appearance, while leaving the sides and back unobstructed for reaching the trains easily. Extra train equipment is kept in cupboard that forms bed's headboard.

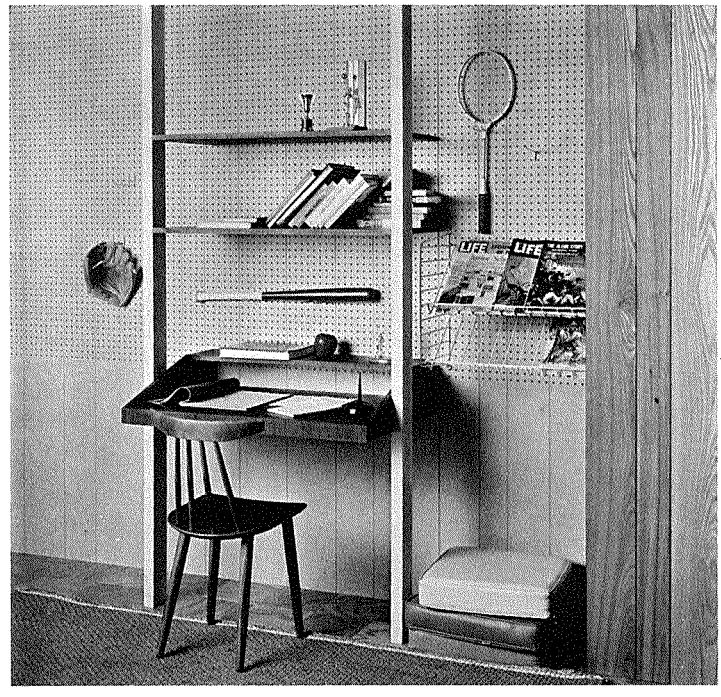




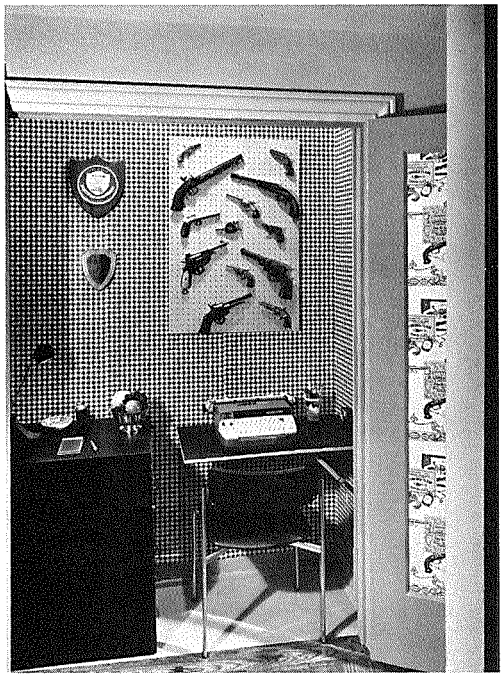


SPECIAL COMPARTMENTS in this roomy storage unit take all the bulky things that never seem to fit anywhere—campstoves, sleeping bags, fishing-tackle boxes, ski boots, life jackets and similar outdoor gear. The tall section on the left side lets you slip skis, fishing poles, boat oars and other long items down behind a shelf where they're kept out of the way at the back. A hinged shelf swings out to provide space for working on equipment. Above this are two drawers for small items such as fishing reels and ski goggles.


SHELVES ON CLEATS
PLANK SIDES, BACK AND DOORS
DRAWERS
DROP-DOWN WORKTABLE
APPROX. 38" DEEP x 80" LONG
PARTIAL SHELF LEAVES SPACE AT BACK FOR TALL ITEMS

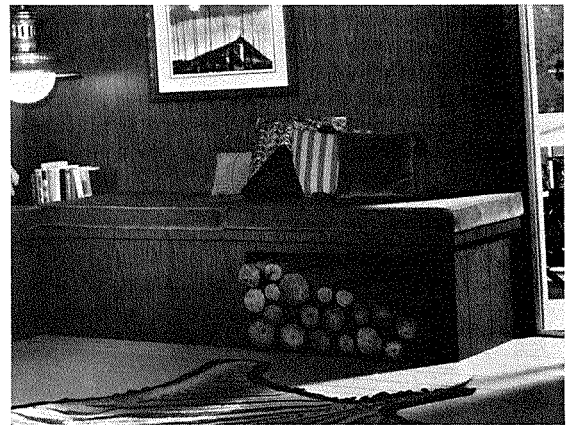


A COMBINATION of perforated paneling and floor-to-ceiling poles creates this unusual storage arrangement for a playroom, den or child's bedroom. The square two-by-two poles, spaced about a foot away from the wall support the front edges of shelves, while the rear edges rest on shelf brackets hooked into the paneling's holes. A small desk is also suspended between the poles. Special Georgia-Pacific V-grooved hardboard paneling has perforations in upper two-thirds and is solid at bottom for a wainscot look.

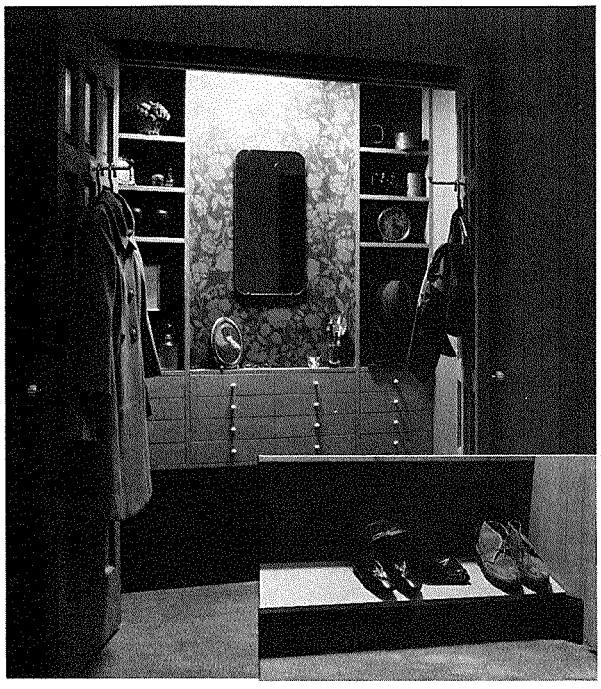


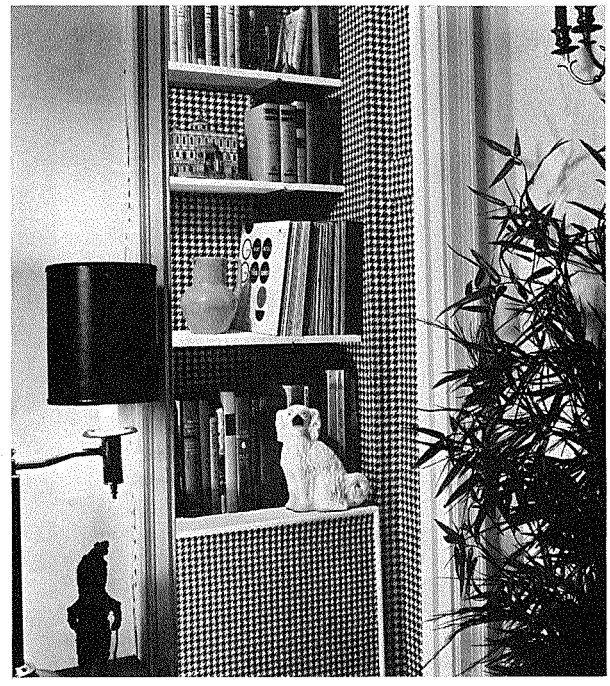
AN UNUSED DOUBLE closet becomes a small home office at left. Lined with bright checkered wallpaper, it provides enough room for a typing table and file cabinet. With doors closed, it's quickly hidden from view. A similar closet is converted into an attractive vanity alcove in left-hand photo on opposite page. Shallow shelves and drawers at back hold toiletries, yet still leave space for hanging clothes. Inset photo shows handy sloping shoe rack under drawers. Makeup mirror is indirectly lighted from recessed fixture above. At far right, single closet with doors removed becomes a bookcase helping to make a small room seem much bigger.

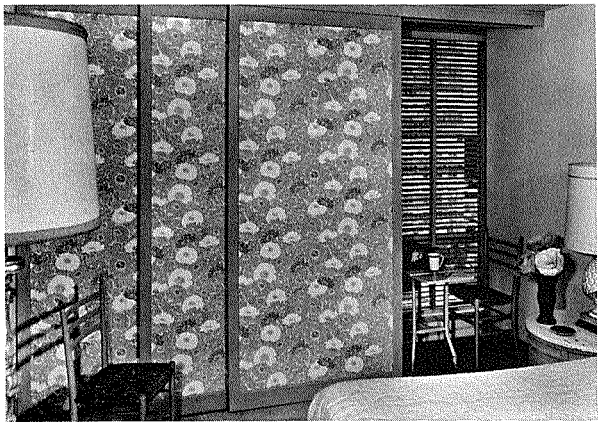
PADDED BENCHES along a wall are an easy way to gain extra seating space and at the same time add storage room inside. Bench at right makes use of space at one end as a bin for fireplace logs. Additional compartments along the bench hide assorted household items behind cupboard doors. Lift-up seat-tops are another good way to get at space inside a bench and save the framing and fitting required for doors. Such under-bench bins are ideal for holding a slide or movie projector, musical instruments, record collections and stacks of sheet music or old magazines. Slide-out drawers can also house a phonograph and other hi-fi equipment. Bench can be sized to take cushions in 18, 20 and 24-inch squares.

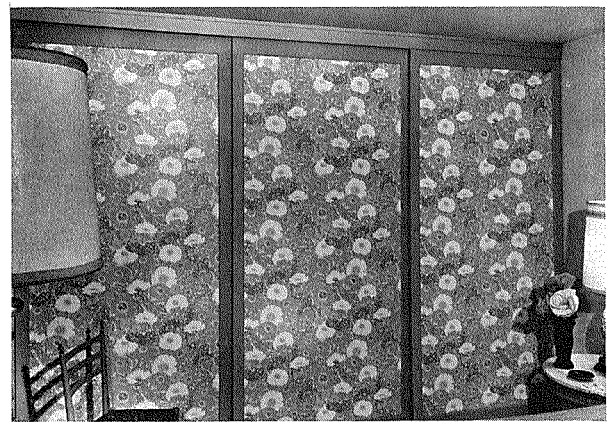


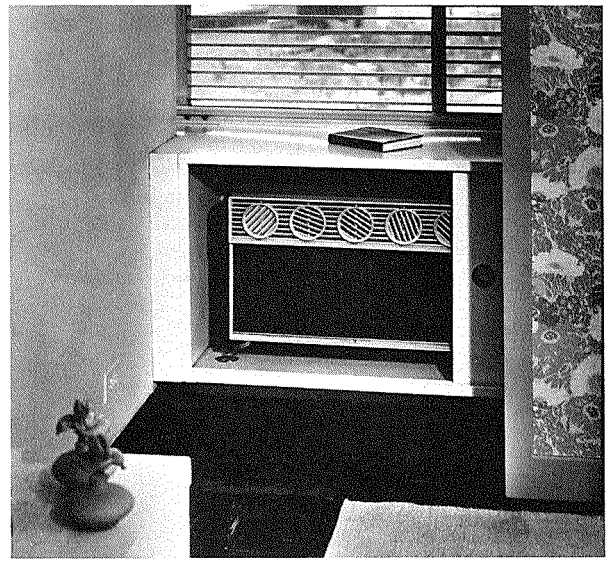
SWING-UP TOP on this versatile hobby bench opens to provide a convenient work area underneath for building models, electronic kits and other small projects. With the top closed, delicate parts and partially assembled projects are protected from damage between sessions. Upper surface also serves as a desk top for doing homework. The design permits quick cleanup since tools and parts don't have to be put away—you just close the lid down over them. Sides around the work area keep tiny pieces from getting lost. Adjustable shelf standards on the walls store supplies and display completed projects handsomely. They can be put up in various arrangements.



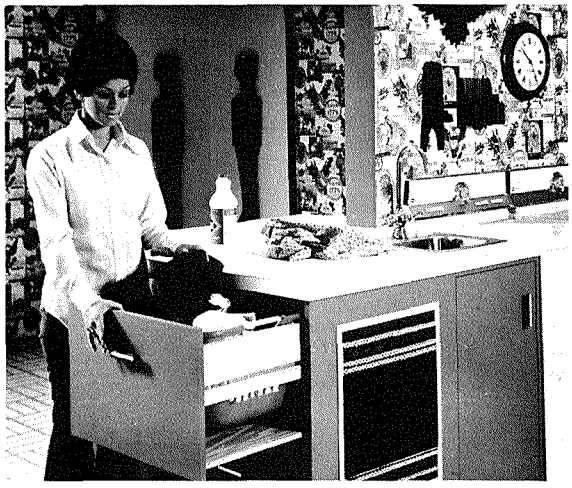


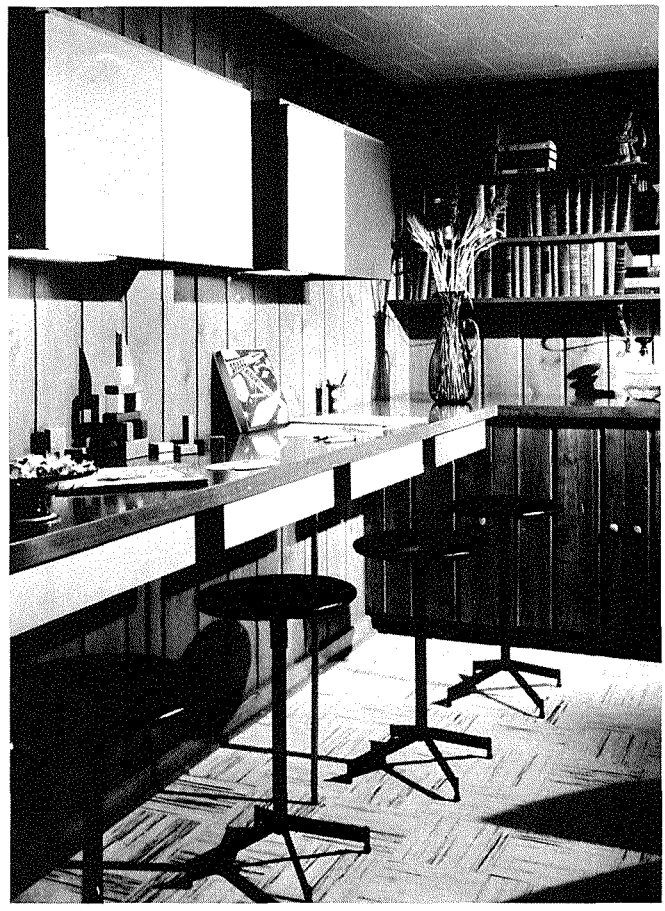




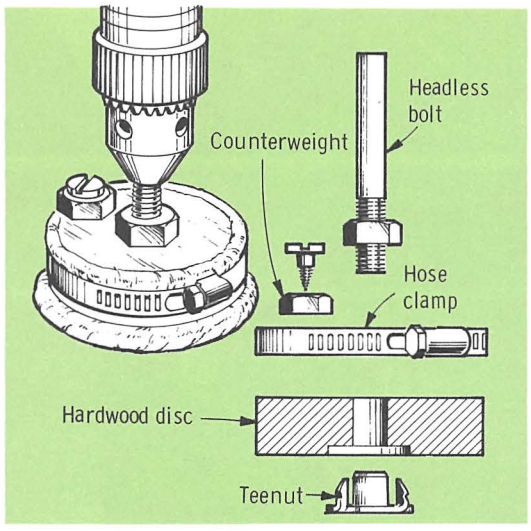


STEALING A SMALL slice off an existing room can often give you needed space for special activities. A sliding partition like one above can hide a sewing nook, a hobby bench, a desk, a bar for parties and equipment that must be readily available yet out of sight. It's also useful for screening off a TV set or airconditioner, as at night. Wall shown here is made of framed plywood panels, wallpapered, that slide in floor and ceiling tracks.

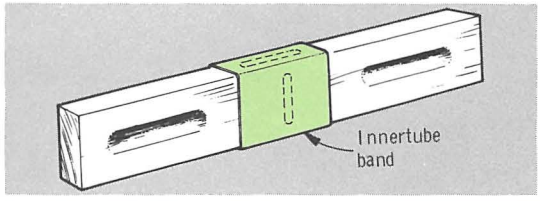




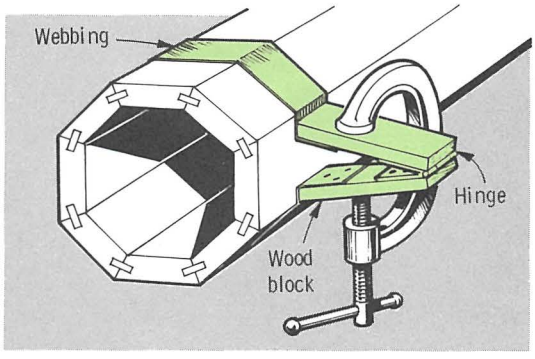
OCCUPYING NO MORE than 6 feet of space, the island clothes sorting cabinet (above) can add a world of convenience and efficiency to a home laundry. The pretreatment sink doubles as a member of your laundry team and a clean-up area for messy fingers. The island's many drawers make it a fine companion for any washer/dryer. A wall-supported counter fitted with drawers and equipped with bar stools (upper right) provides a work/study area for the whole family. Each youngster can have his own "desk" for homework or craft activity. It's an excellent place to budget the family paycheck and plan menus. The shelf is solidly supported by protruding 2x4s anchored to wall studs. The counter is covered with Formica and each area is complete with drawer. Low-bridge areas (right) back under sloping roof of attic rooms are waiting to store countless items such as luggage, Christmas decorations, seasonal wearing apparel and the like. Standard window shutters, hinged and held shut with magnetic catches are used to make attractive and inexpensive doors.



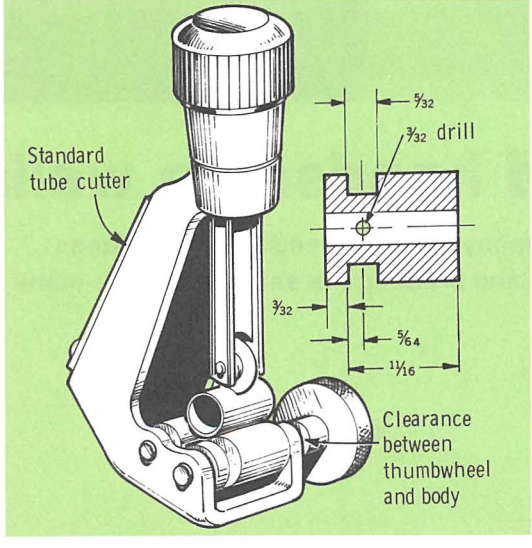
SMALL FLAT ITEMS can be polished on your drill press with the easy-to-make polishing pad detailed at the left. The pads themselves should be large enough so that their edges can be folded up around the sides of the disc and held in place with the hose clamp. To balance the polisher, add a counterweight on top of the disc on the side opposite the hose-clamp screw. This will insure smooth operation.—*Peter Legon.*



BEFORE CHUCKING a level in your toolbox, make a protective cover for the vials by cutting a wide section from an old bicycle inner tube. Slipped over the level, it will prevent breakage.—*Wilfred Beaver.*



IF YOU DON'T HAVE regular web clamps when it comes to gluing the splined beveled joints of octagonal or hexagonal-shaped work, you can make your own in a few minutes as shown in the detail at the left. Lengths of strong furniture webbing are tacked to the ends of hinged blocks. Then the webbing is pulled tight around the work by drawing the blocks together with a C-clamp.—*Milton J. Hancock.*



BEING ABLE TO ROTATE the tubing instead of the cutter makes it possible to cut extremely short lengths of tubing with a standard tube cutter—something that ordinarily can't be done. To modify the cutter, remove the front roller by drilling out its rivet axle and replacing it with a roller turned from medium-hard urethane. Fit the new roller with a $^{3}/_{16}$-inch axle and enlarge the original rivet holes in the cutter to accept it. Crosspin the roller to its axle and then add a 1-inch knurled knob to the end.

In use, the friction of the urethane roller against the tube, when turned by the knob, rotates the tube against the cutter wheel.—*Robert D. Corwin.*

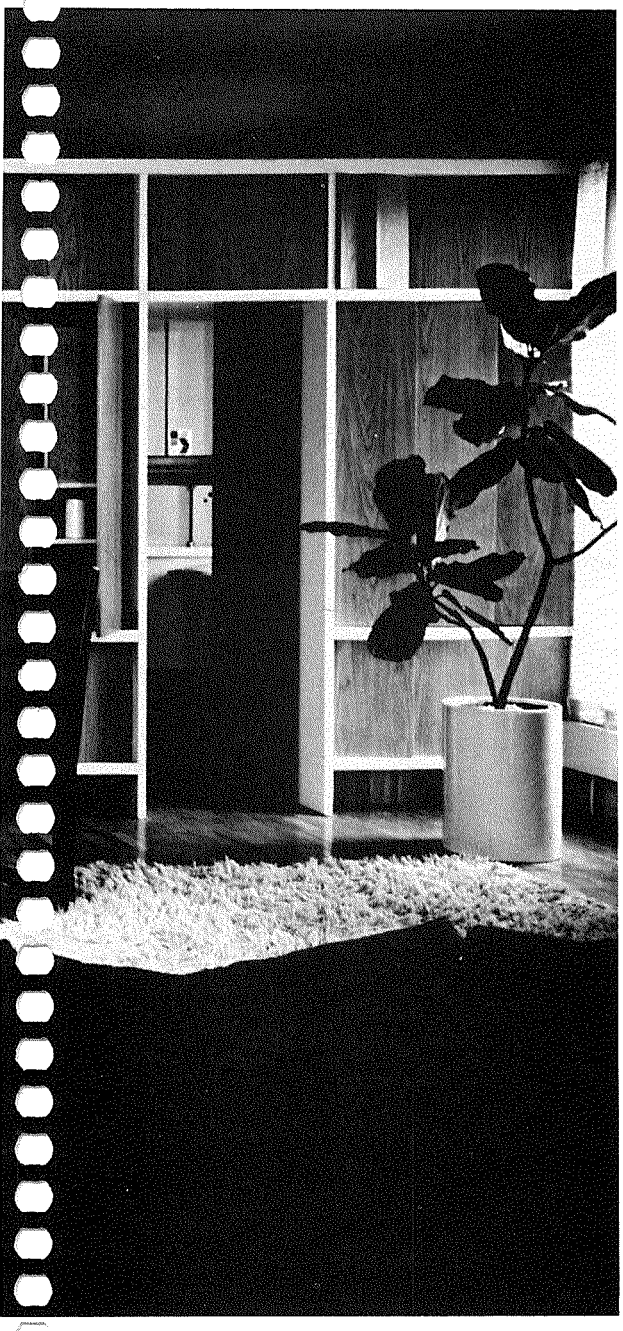
Storage galore behind handsome walls

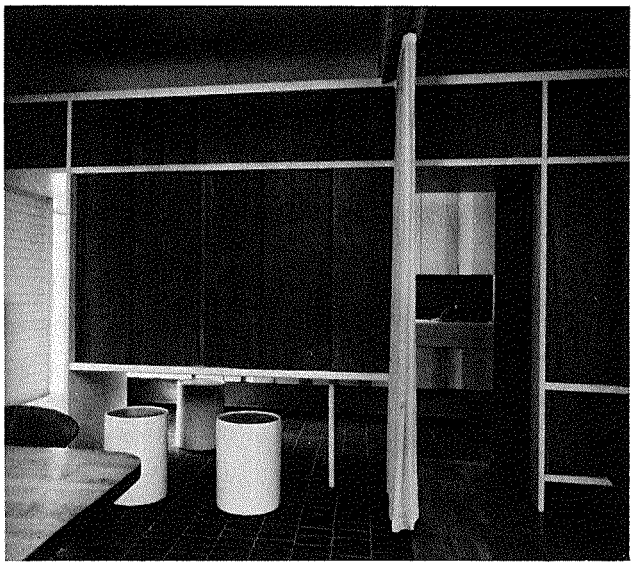
An architect with a design background worked out a good many attractive and functional ideas for storage when he took on the task of remodeling and creating his easy-to-care-for home

SEE ALSO

Bookcase closets . . . Closets . . . Family rooms . . . Hobby centers . . . Kitchen accessories . . . Room dividers . . . Sewing centers . . . Shelves . . . Study centers

By HARRY WICKS



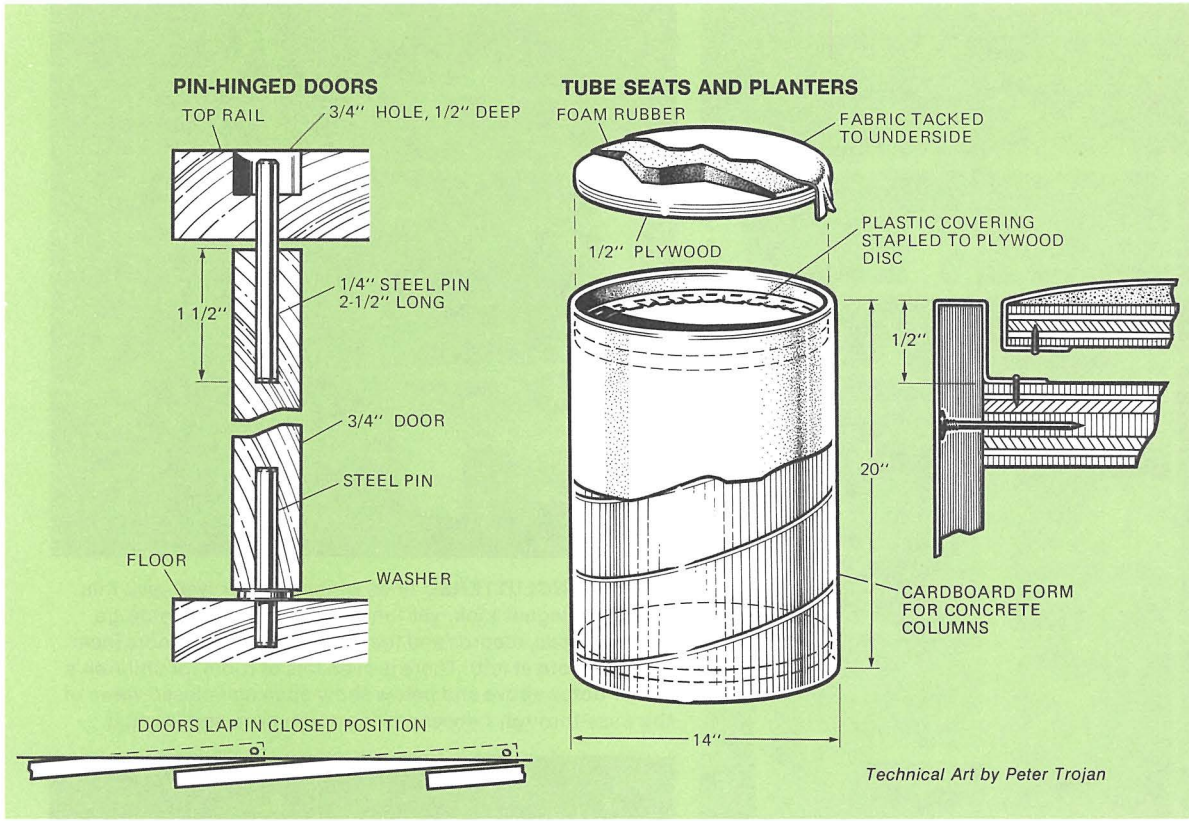


CLEAN, UNCLUTTERED lines of the interior wall give this room an elegant look, yet function for maximum storage. Stereo, books, records and the like are behind the doors (near right in photo at left). There is even lots of room for children's toys. Photos above and below show open and closed views of the pass-through between living-room area and kitchen.

WHEN KARLIS GRINBERGS set out to renovate and modernize his home he knew pretty well what he wanted to do. Like most homeowners, he and his wife desired more storage area, but unlike the average do-it-yourselfer, Mr. Grinbergs is an architect whose design background more than armed him for the challenge confronting him.

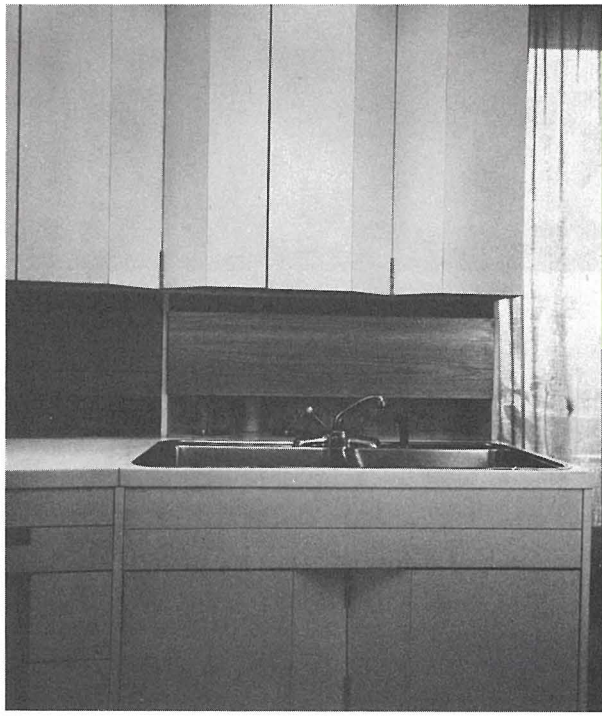
Starting with a carriage house in the Boston area, Karlis laid out, basically, three interior storage walls. Each is distinctive in that necessary hardware—hinges, pulls, catches and the like—are virtually invisible. The major storage wall, shown above, is between the living room and kitchen area. This and the other walls in this home are well-organized and provide neat storage for all family possessions, including the youngsters' toys.

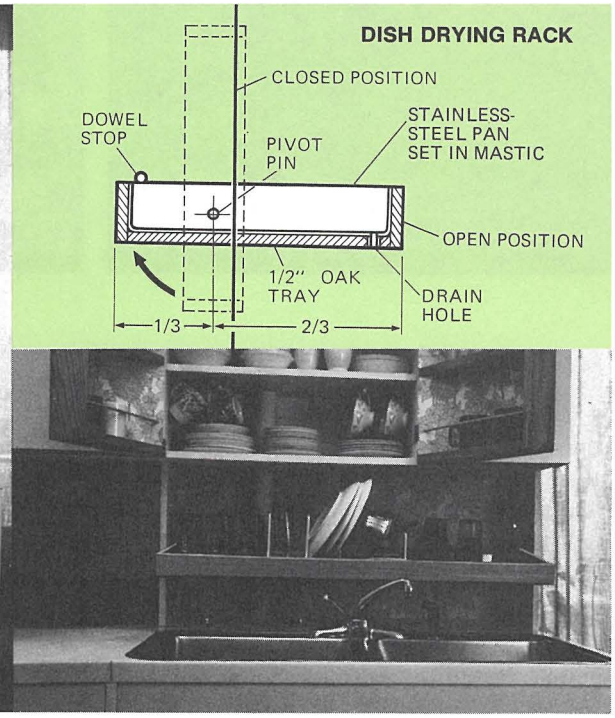
If you study the photos, you will note custom furnishings designed and built by the owner. The

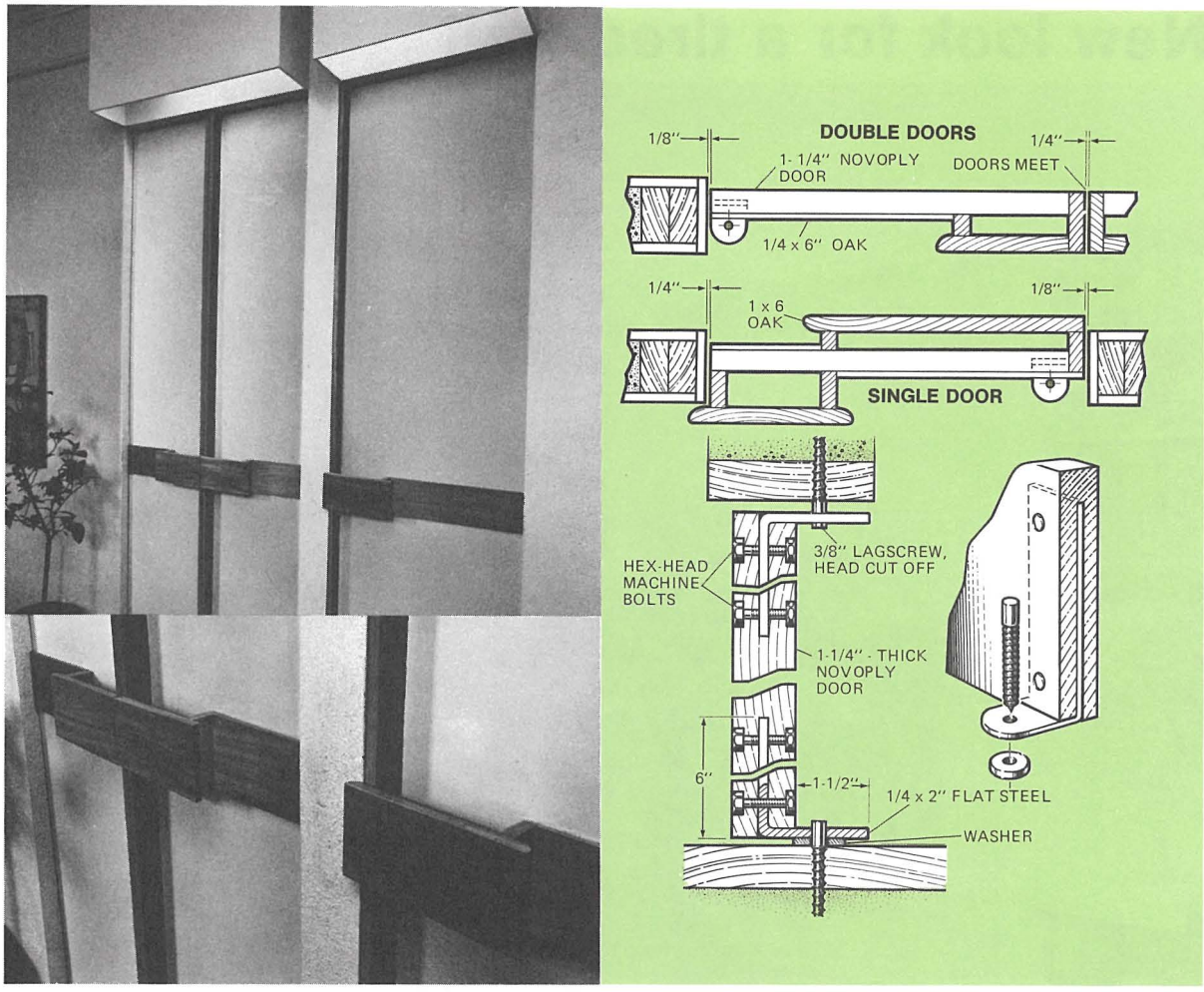


"HINGELESS DOORS" rotate on pins and washer-spacers in a unique system developed by the homeowner. Drum stools (above, right) and the planter shown in the photos are actually cardboard tubing that is used in the formation of concrete piers. The finished product is handsome and functional, yet it is inexpensive to build.

CABINETS ABOVE and below the sink are also designed to be fully utilized. Even the doors, which are lined with a yellow floral vinyl, are fitted with shelves for glasses. A tilt-down board (shown in drawing) is placed directly over the sink to provide a spot for glasses to drain. Drainboard is lined with stainless steel.







CLOSET DOORS feature an ingenious "hinging" and novel pulls (drawing at right gives details). Notice that angle is securely bolted to the door and that the pivot is actually a headless lagbolt. Light fixtures installed over the doors are simply boxes constructed of ¾-in. plywood and used to conceal fluorescent tubes.

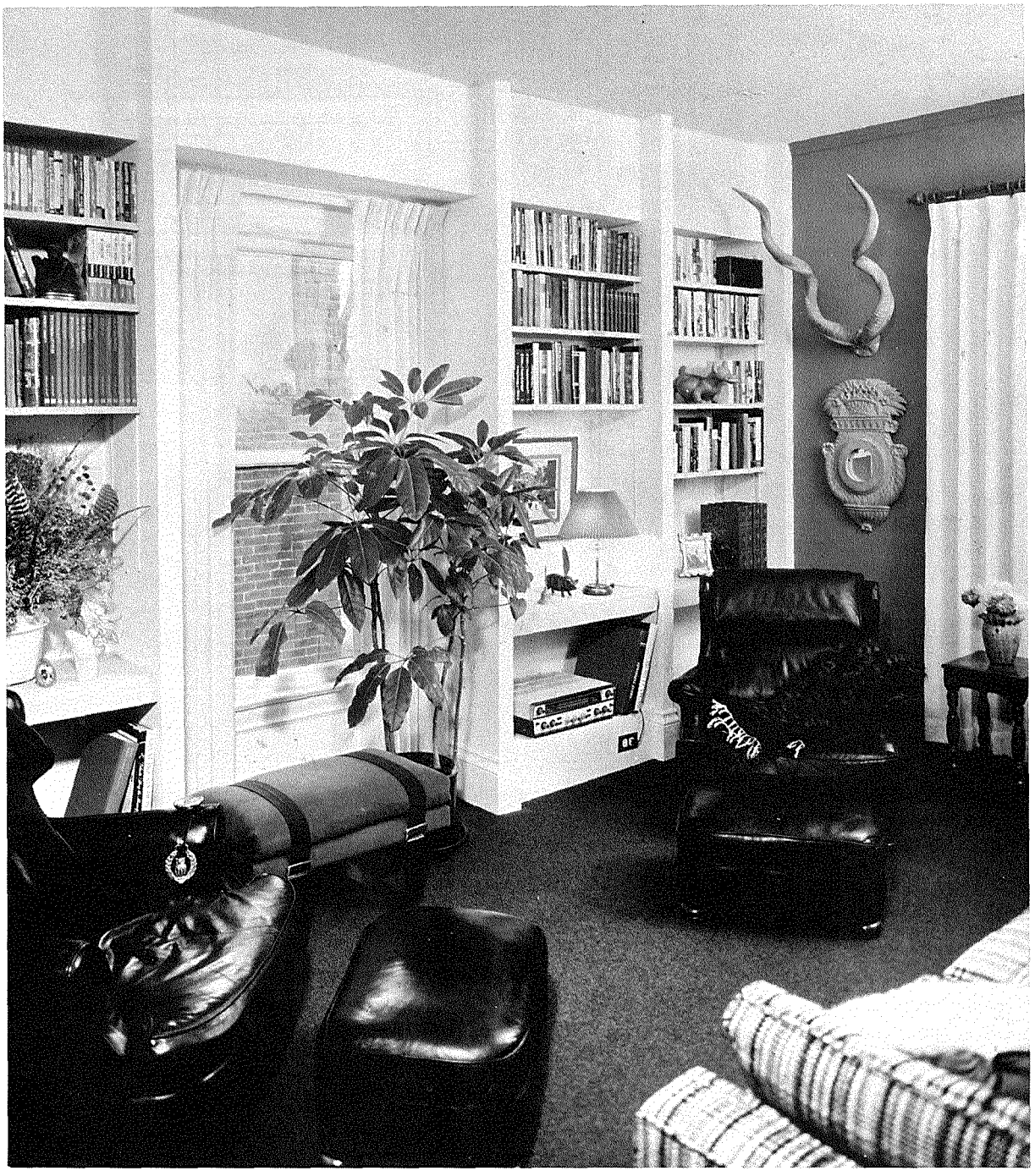
"stools" typify Karlis's ingenuity. As can be seen in the drawings they are made by cutting down and covering cardboard forms used for pouring concrete piers. The tubes are available at well-stocked building supply houses. (One brand name is Sonotube.)

Though not a cabinetmaker or carpenter, Grinbergs tackled the bulk of the remodeling work himself. He had to. Since he prefers invisible hardware, he got down to the nitty-gritty mechanical design stage as he came upon each individual challenge. Once his design ideas were worked out on paper and the kinks removed in prototypes, the rest was clear sailing. That's where you can start from; the details are shown in the drawings.

In addition to using bold, bright splashes of color carefully throughout the structure in combination with varying textures such as stone and paneling, the Grinbergs carefully selected their furnishings for total compatibility. The overall feeling of the house is that it is indeed lived in, yet lacks the clutter that plagues most active homes.

The house is full of ingenious space and labor-saving devices. For example, the kitchen cabinet shown features a drainboard that flips up when not needed. The door "pulls" don't look like pulls but appear to be decorative architectural accents. Grinbergs' design ideas are unique, functional and add to overall room appearance.

New look for a tired wall



SEE ALSO

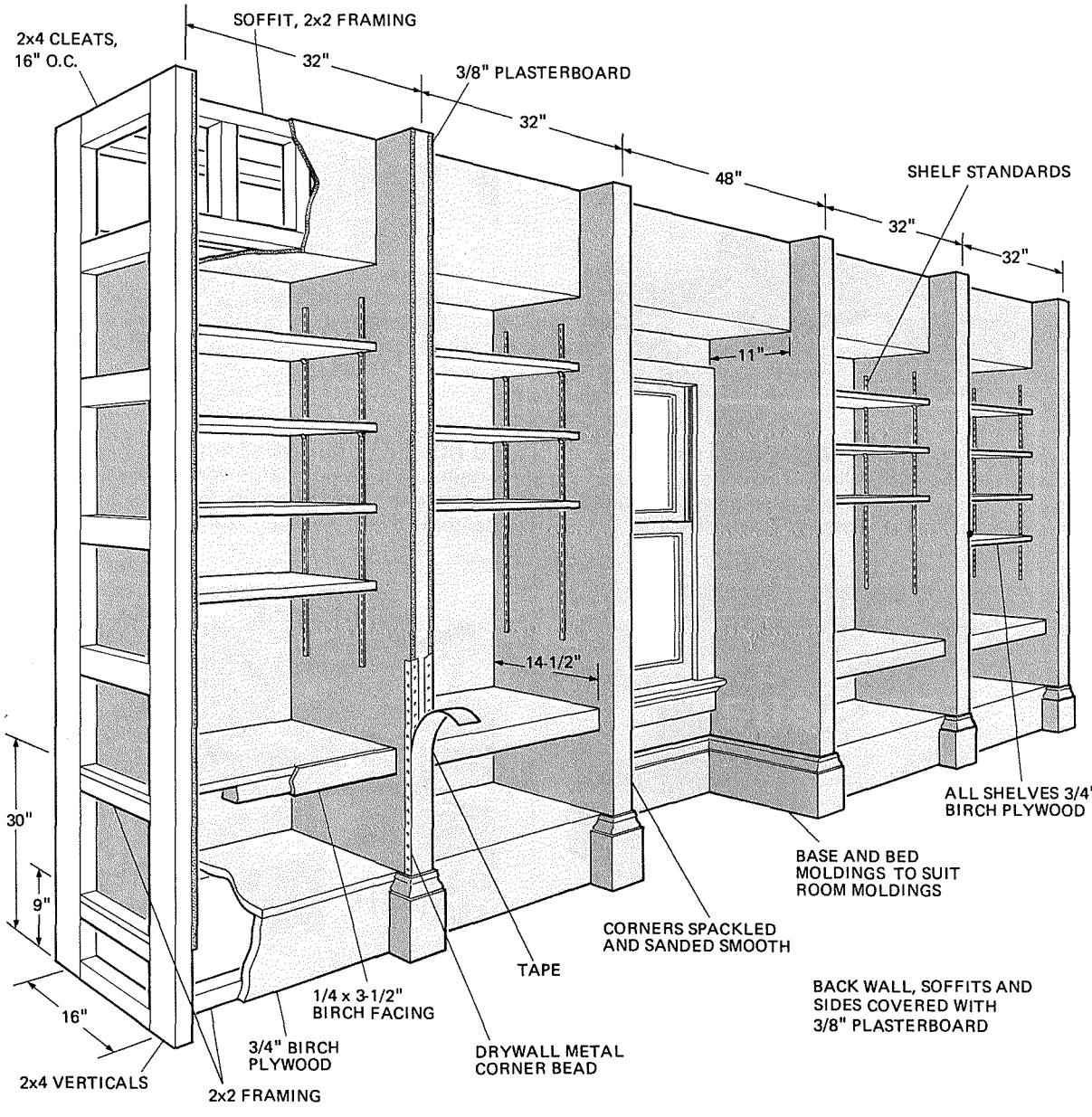
Bookcases . . . Cabinet furniture . . . Hi-fi centers . . . Room dividers . . Shelves . . . Study centers

SETTLING CAUSED the outside wall to crack and the ceiling joists to sag in one of the upstair's bedrooms of James Cherry's 80-year-old house in Minneapolis. While repairing the wall, Mr. Cherry got the idea to convert the seldom-used guest room into a den-sitting-room-library where he could relax, read and listen to music.

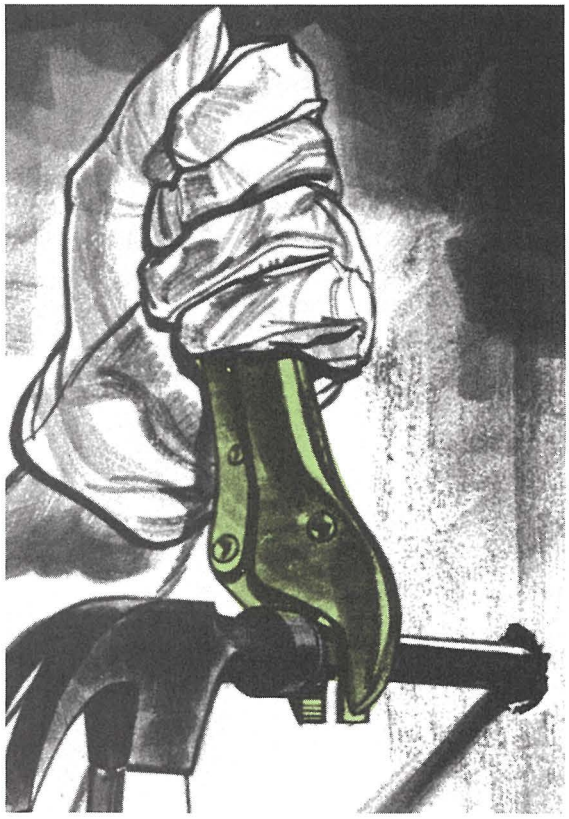
Because the room is large with a high ceiling,

the owner wanted to create a feeling of intimacy. After considering the options, he achieved this effect by filling the window wall from floor to ceiling and corner to corner with the bookshelf system shown on these pages. Visually, the change reduces the room in size; practically, it hides the cracked wall and gives support to those sagging ceiling joists.

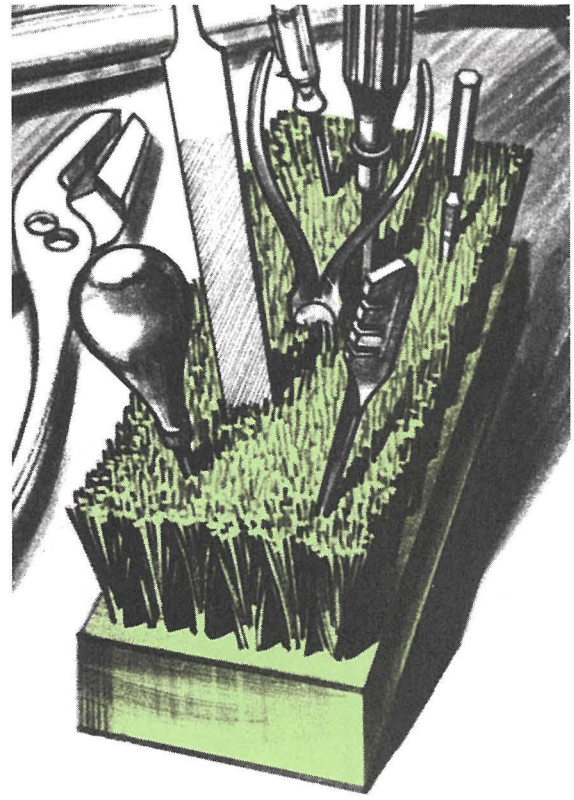
The wall system designed by Mr. Cherry is based on plasterboard-covered 2x4 frames with shelving in between. For visual uniformity, the dropped soffit was built-in. The design can easily be adapted to any size wall with a little careful planning. Desk-level and floor-level shelves project slightly more than bookshelves to lessen the dominance of the vertical fins.



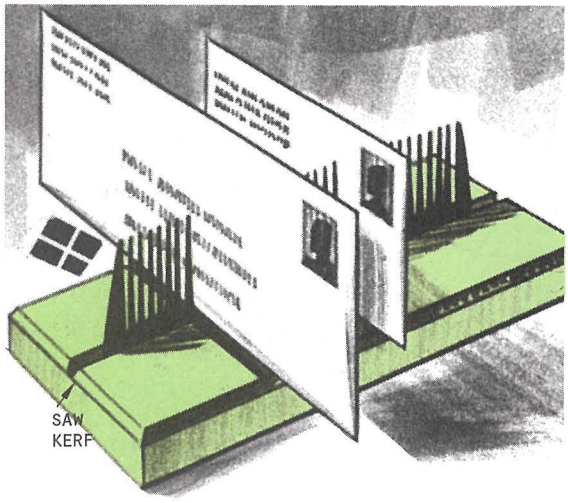
AN UNUSED BEDROOM was converted to the combination den-sitting-room-library at the left. This sturdy wall unit has several shelves for books and speakers, four desk-level shelves for lamp and decorations, and four floor-level shelves for the stereo receiver and more books. It makes the room feel more intimate while supporting sagging ceiling joists.



THE MOST EFFICIENT WAY to use a star drill is to clamp it in Vise-grip pliers. This eliminates the risk of hitting your hand and also gives you added leverage, making it easier to rotate the drill.

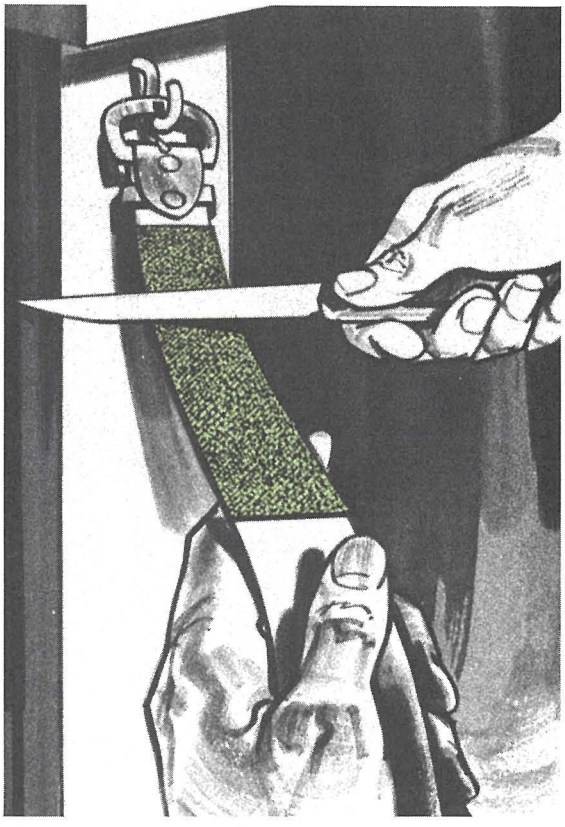


TO HOLD SMALL TOOLS while working on a project, just place a large scrub brush on your bench with the bristles up. Poke the ends of the tools down between stiff bristles.



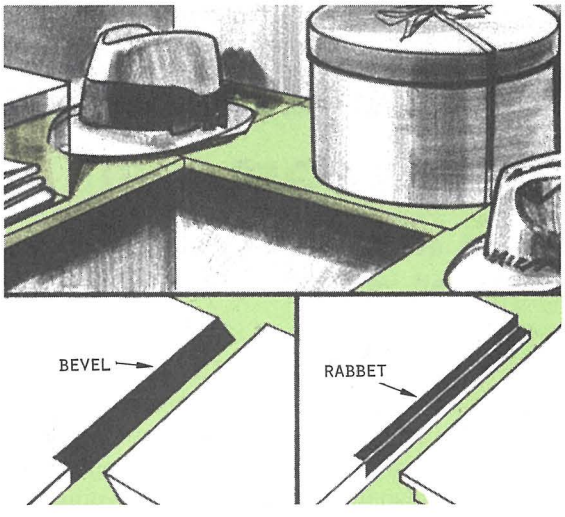
THIS MODERN LETTER RACK is a simple one-hour project. Just cut a shallow saw kerf down the middle of a block of hardwood. Finish the block and cement a coarse-toothed steel comb in the slot.

IT'S IMPOSSIBLE to eliminate the mess involved in removing paint. However, sawdust sprinkled over the surface before the remover has set up will stick to the old paint and make the sludge easier to remove.

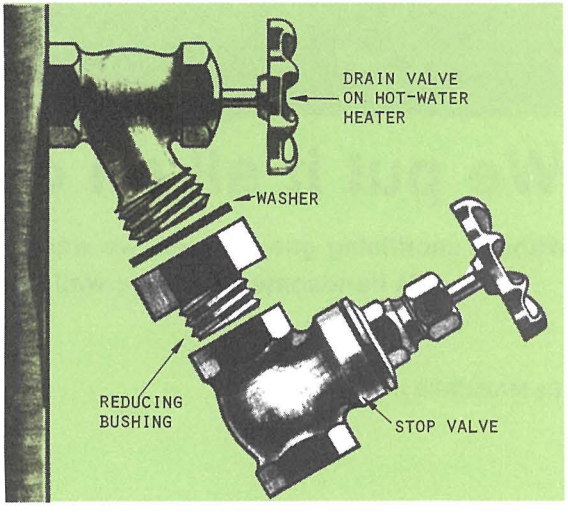


TO KEEP A GOOD EDGE on shop knives and other workshop tools, cement a strip of fine emery cloth to an old leather belt and hang it on your workbench. Use the other side of the belt to strop.

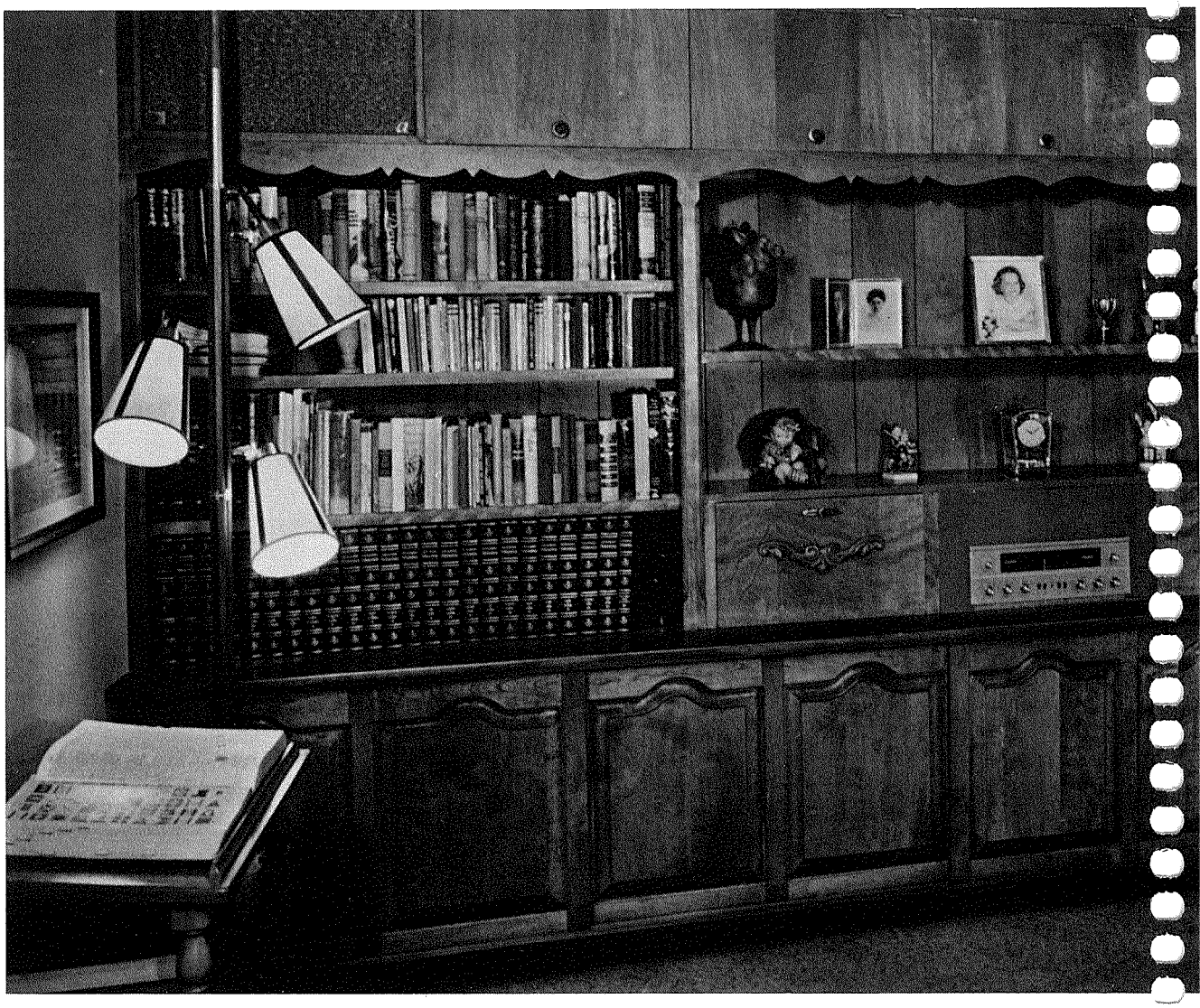
CAMPERS WILL FIND 35-mm film cans handy for carrying many things. Being watertight, they're fine for matches. You can also glue foil over openings and punch holes to make salt shakers.



ONE METHOD of supporting a shelf at the end of a closet is to half-lap or angle-cut the ends to fit corresponding cuts in the side shelves. Joints may be secured with glue and small nails or screws.



A PIGGYBACK VALVE added to the leaky drain valve of a furnace or water heater lets you stop the leak without emptying the tank. Use a reducing bushing and pipe-joint compound to mount a stop valve.



We put it all on our living room wall

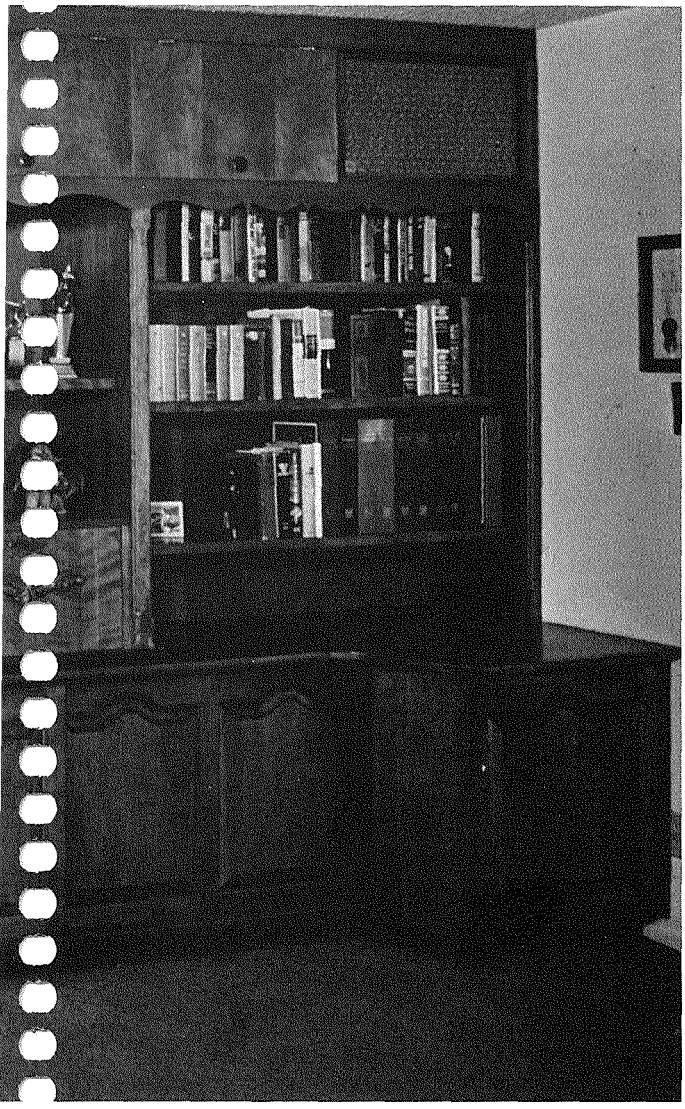
Without sacrificing good design, we were able to include everything from a stereo system to a this handsome bookcase wall. By doing it yourself, you can save a bundle—as much

By MARJORIE JOHNSON

SEE ALSO
Bookcases . . . Desks . . . Hi-fi centers . . . Modular furniture . . . Remodeling . . . Room dividers . . . Shelves . . . Study centers . . . Wallshelves

■ A 14-FOOT BLANK WALL turned out to be the key to solving our storage problems. Using the full height and width, we were able to design a built-in entertainment wall that not only holds books, but also includes a concealed typing desk and a surprising amount of general storage space. Best of all, by doing the work ourselves, we were able to save $500 from the estimate given us by a professional cabinetmaker.

At the outset, we were a bit hesitant to tackle the job ourselves. But we knew just what we wanted and we planned so everything would fit just right. Our local lumber retailer helped in the



oncealed typewriter desk in
ıs $500, we found

selection of materials; he also showed us how we could save through a smart lumber-cutting schedule, which is not as difficult as it sounds. This is how it went:

The countertop and lower unit rest on a 2 x 4 base which forms a recessed toeboard. The top extends 21 in. out from the wall for most of its length. At the desk end, however, it increases to 33 in. This deeper portion holds the typewriter shelf which can be slid out and raised to counter height.

Our 27-in. TV is located in the center of the base unit. Space on either side is devoted to general storage. We installed shelves in the side cabinets, but these could be omitted if you plan to use the space for bulky items. Sliding doors in aluminum tracks conceal all these storage cabinets and the TV.

Above the counter, the space is divided into three open sections—a wide 6-ft. section in the middle to hold the stereo equipment and provide display shelves, and two 4-ft. bookshelf sections on the ends. All three sections are equipped with adjustable shelf brackets, so the height of the shelves can be changed to suit your books or art objects.

The bottom portion of the middle section is a permanent enclosure in which the stereo equipment is mounted. Our tuner/amplifier is located in the center, directly above the TV. To provide a decorative touch, the area around it is covered with gold mesh screening backed with acoustical cloth. The doors on either side conceal the tape deck and turntable. Centered on each of these doors is an ornamental leaf molding stained to match the rest of the wood and glued to the face.

We chose standard 1⅛-in. bookshelf stock for all of the upper shelves because it's thick enough not to require center supports. It measures 12 in. deep.

room for extras

The top 2 ft. of the unit holds a pair of stereo speaker enclosures, one at either end. Five 2-ft. doors give access to the long space between these speakers, which we use to store seldom needed games and other recreational gear. The doors are hinged at the top and equipped with folding brackets to lock them open.

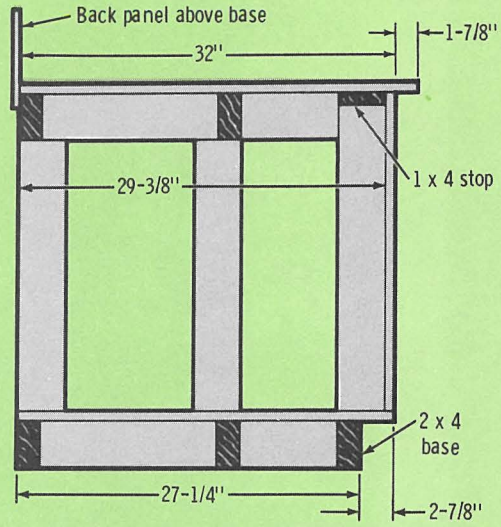
All the exposed surfaces are birch. Although the unit is fastened to the wall, we backed the shelf sections with prefinished, random-width birch plywood to give it a cabinet look rather than leave the wall exposed. We colored the unfinished parts of the unit with a mix of equal parts of fruitwood and maple stains, followed by a coat of clear varnish and two coats of satin varnish. All surfaces were rubbed with fine steel wool between coats.

If the fancy, beveled panel inserts in the sliding doors are too difficult for you to copy, forget the curved top part and substitute a plain beveled insert. This is easily made by tilting the blade on a bench saw and running the work through on edge, after first making the raised shoulder cuts.

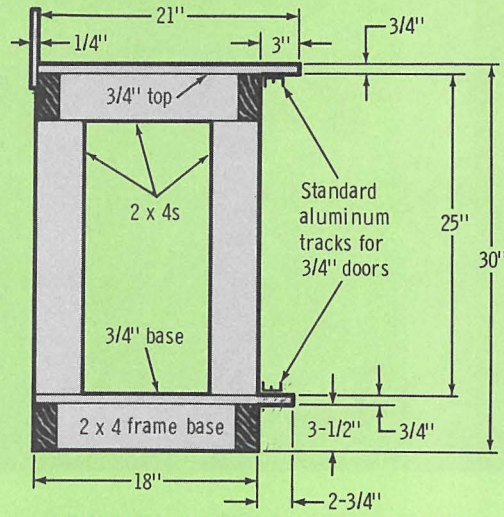
put it on the wall, continued

put it on the wall, continued

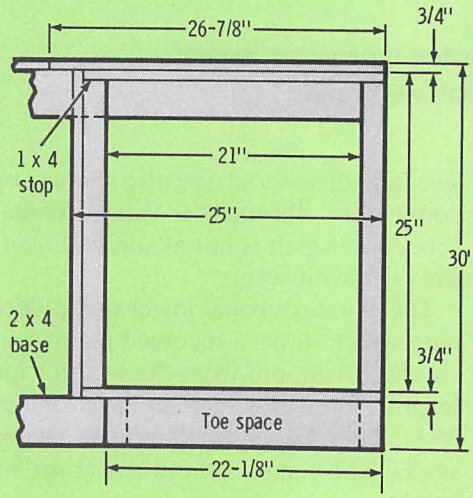
DESK built into one end holds typewriter shelf mounted on standard desk hardware.



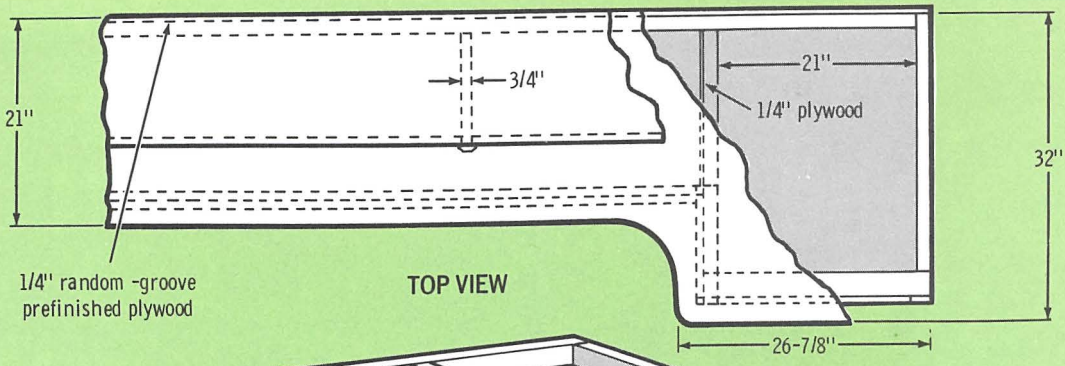
SECTION SHOWING LEFT END OF TYPING UNIT

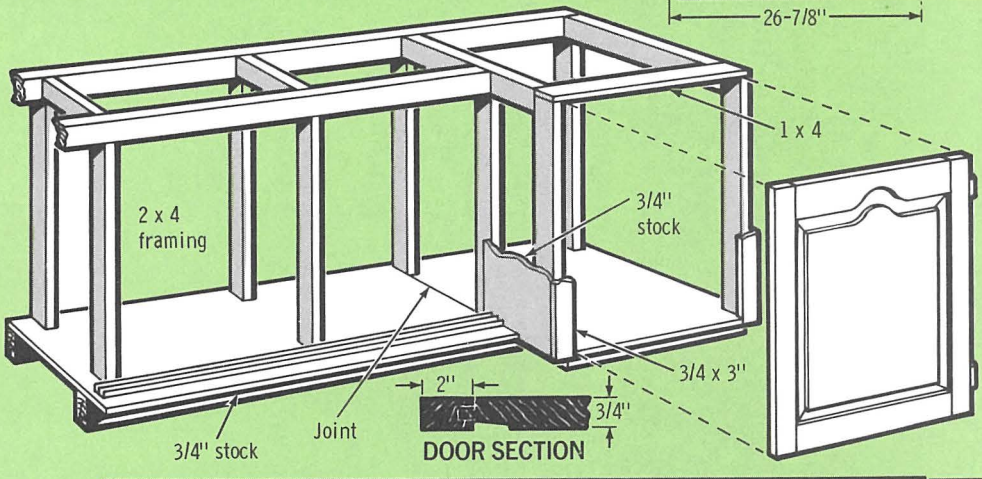


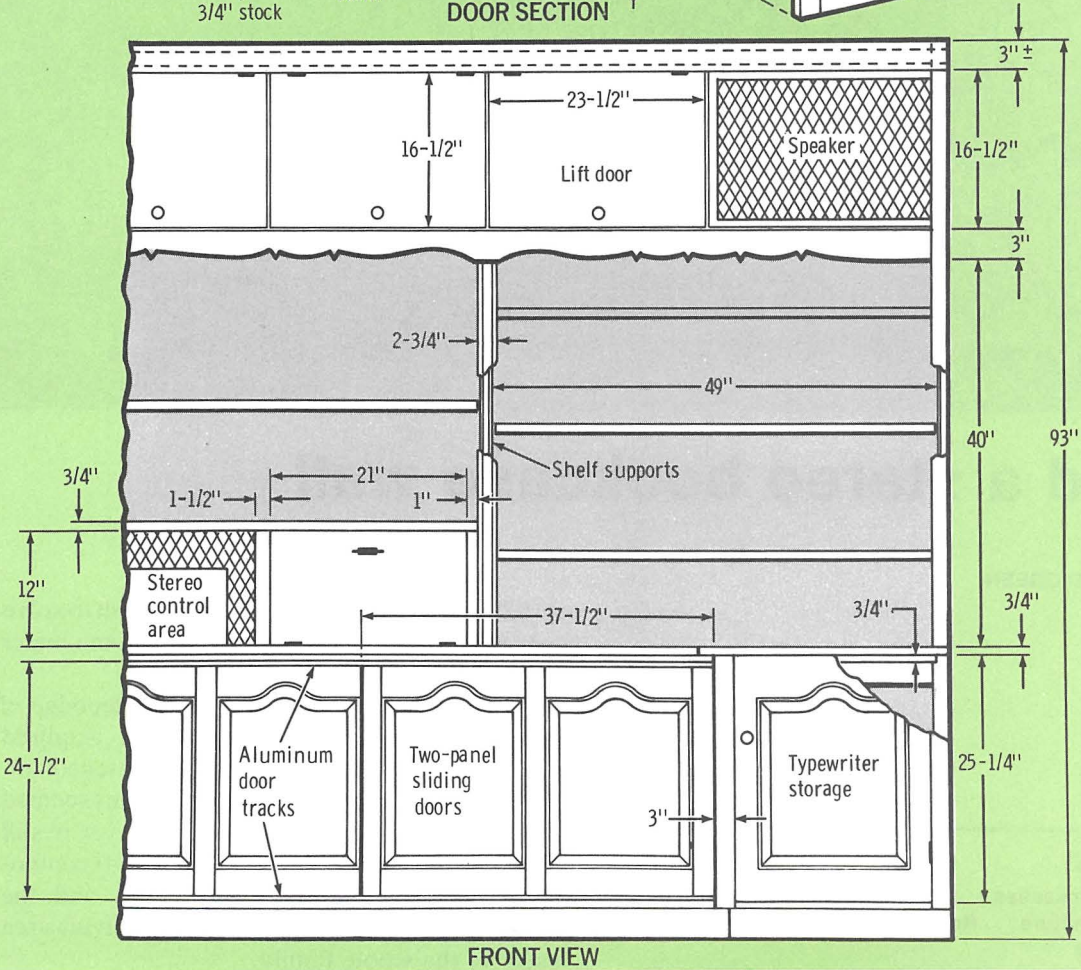
SECTION SHOWING LEFT END OF BASE

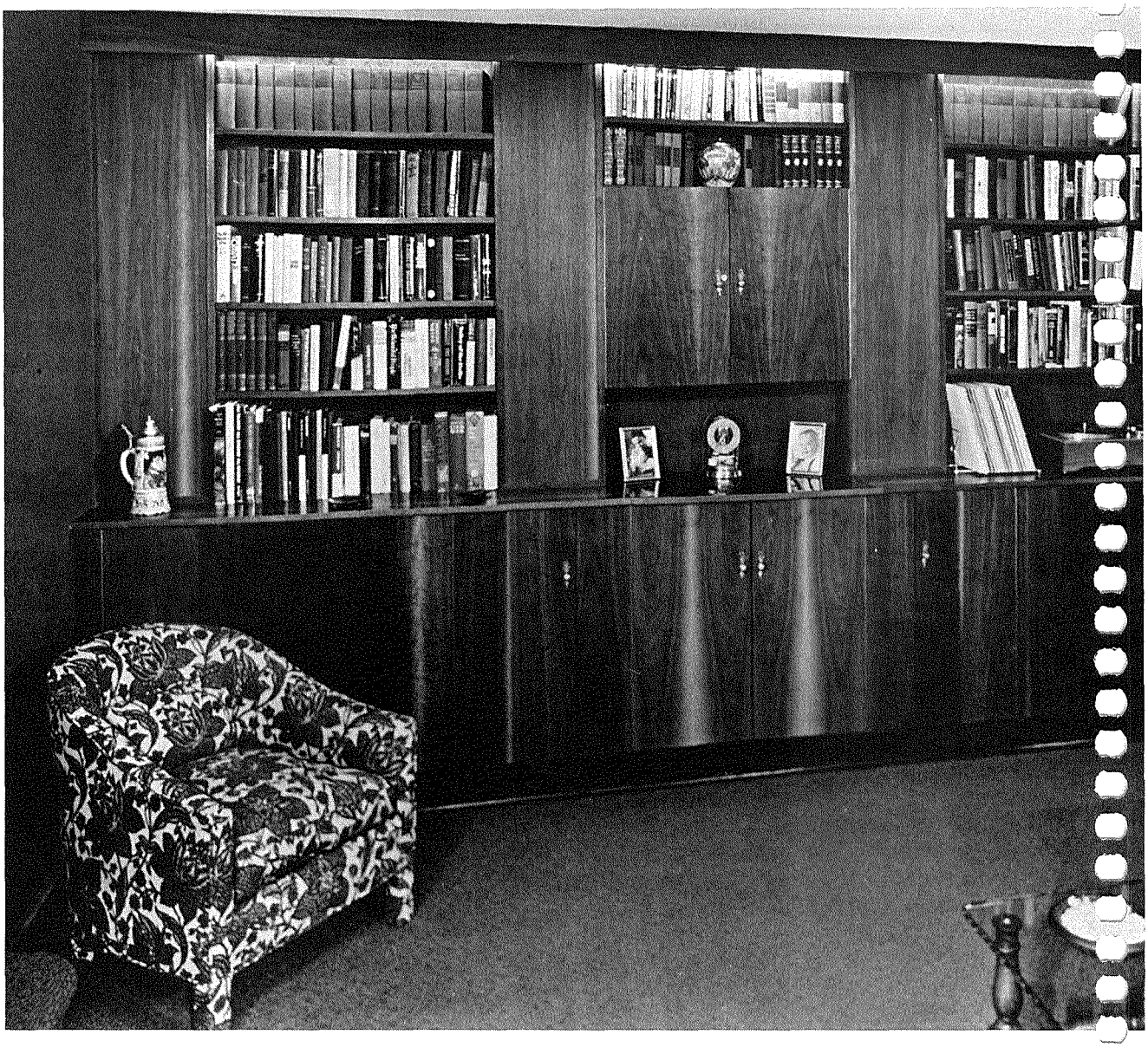


FRONT VIEW SECTION OF TYPING UNIT


21"
3/4"
21"
1/4" plywood
32"
1/4" random -groove
prefinished plywood
TOP VIEW
26-7/8"


1 x 4
2 x 4
framing
3/4"
stock
3/4 x 3"
2"
3/4"
3/4" stock
Joint
DOOR SECTION


3" ±
16-1/2"
23-1/2"
Speaker
16-1/2"
Lift door
3"
2-3/4"
49"
40"
93"
3/4"
21"
Shelf supports
1-1/2"
1"
12"
Stereo
control
area
37-1/2"
3/4"
3/4"
24-1/2"
Aluminum
door
tracks
Two-panel
sliding
doors
3"
Typewriter
storage
25-1/4"
FRONT VIEW



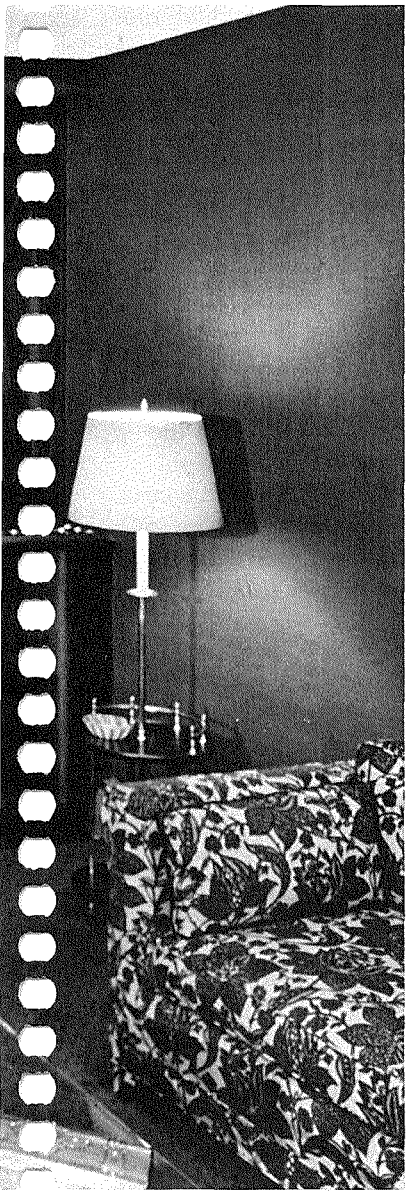
Build a stereo bookcase wall

By HOWARD GREEN

SEE ALSO
Bars . . . Bookcases . . . Hi-fi centers . . . Modular furniture . . . Room dividers . . . Stereo . . . Wallshelves

I DESIGNED this entertainment wall to solve a number of problems, all of which come under the general heading of "clutter."

Our den was crammed with a hodgepodge of small storage units which we had acquired piecemeal over the years. This mismatched collection of bookcases, cabinets and tables seemed to be crowding us out of the room, yet it still didn't provide adequate storage for hi-fi components, television, books, magazines and the other things that end up in an informal living area used by the whole family.



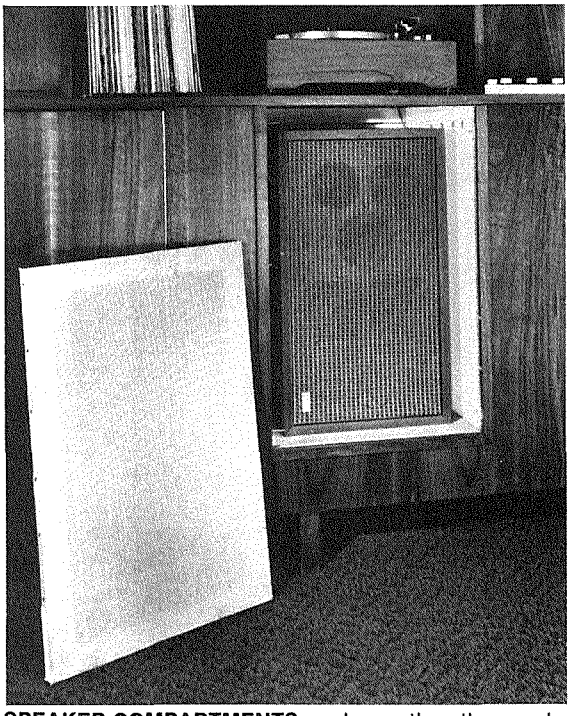
A built-in sound system, a bar, dozens of feet of bookshelves, cabinets to hold games and puzzles and lots of storage are all found in this total wall system. It was designed to replace a large number of small storage units that didn't match or do the job

The solution seemed fairly obvious—a single unit to replace the many small ones. It would have to be large enough to meet our storage requirements, yet occupy a minimum of precious floor space. And it would have to "blend" with the room.

I decided on a ceiling-height design reaching all the way across one end of the room. While this had the effect of shortening the room slightly, it took full advantage of the space available without leaving any empty corners which would be of little practical use.

The primary material I chose was ¾-in. walnut-veneer plywood. This was used for all the exposed surfaces, with ¼x1-in. walnut strips as molding for the four columns and around the speaker openings.

Regular fir plywood worked fine for all the concealed surfaces—¾-in. inside the cabinet and ¼-in. behind the shelves. The ¼-in. plywood was given a coat of walnut stain, though it's almost completely concealed by books. I applied an oil finish to all exposed surfaces, not only because of the way it enhances the walnut



SPEAKER COMPARTMENTS are larger than the speakers to permit proper positioning for best stereo sound.

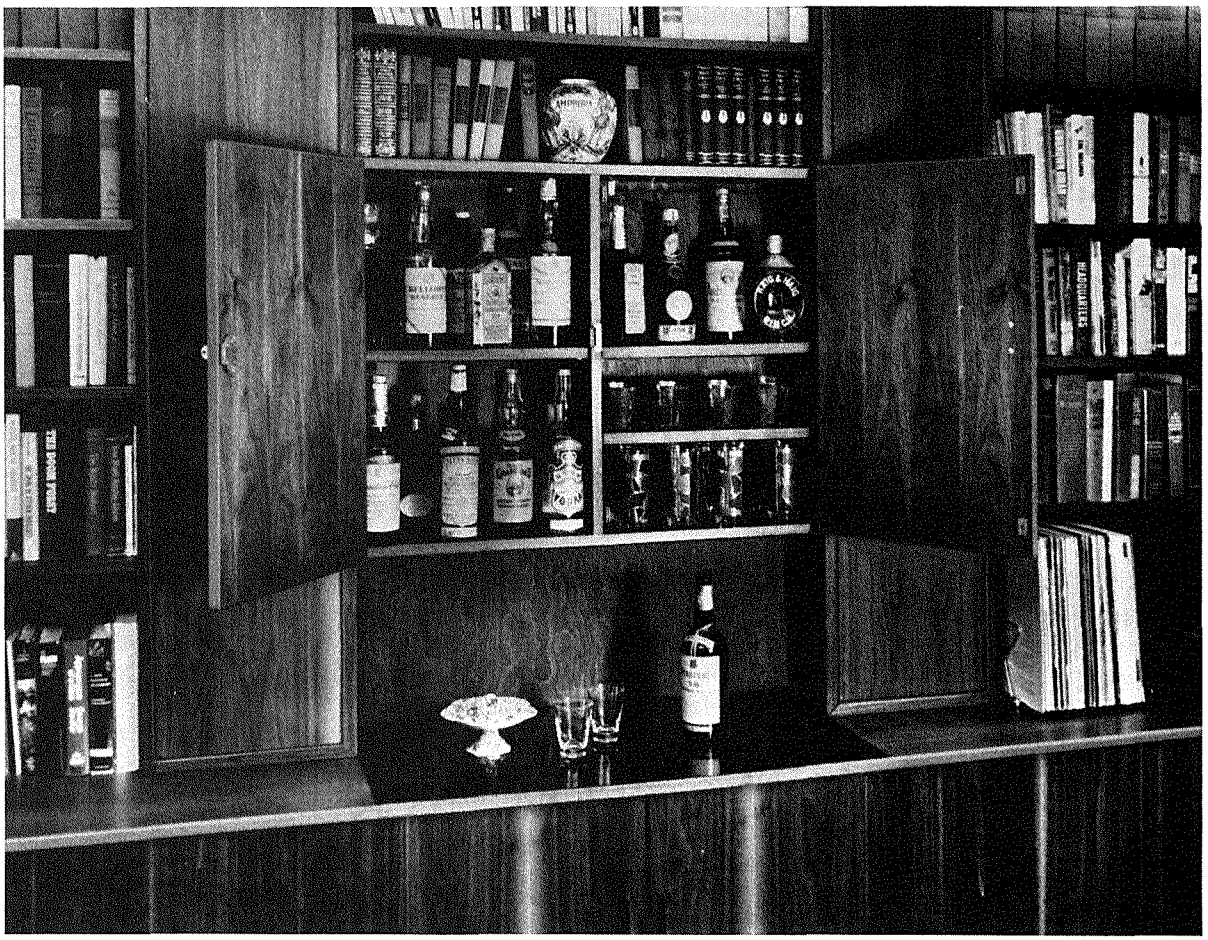
grain but also because it is relatively childproof and easily repaired if scratched or otherwise marred.

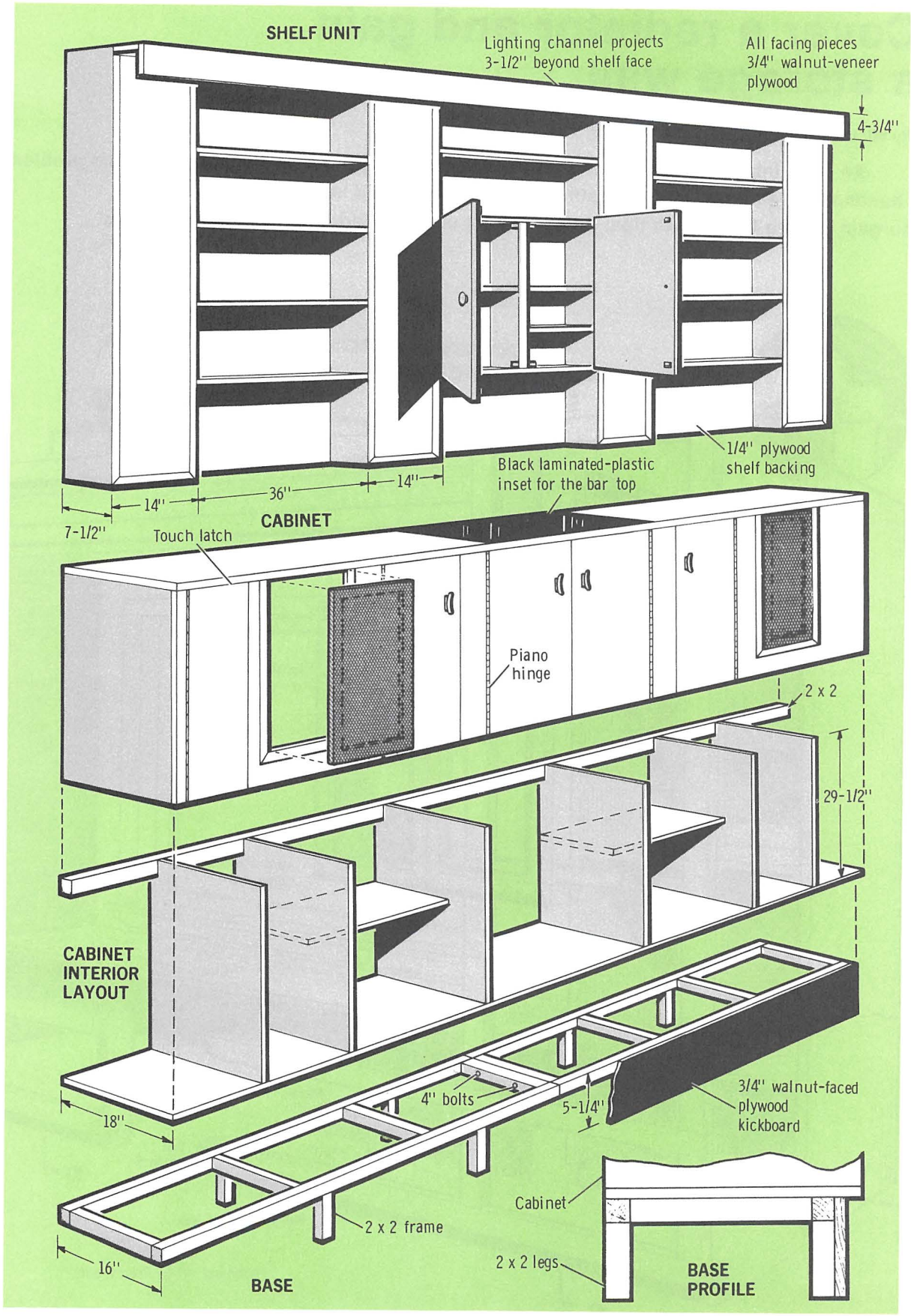
The TV occupies the center cabinet just below the laminated-plastic bar top. It's a small table model which doesn't take up all of the space in this compartment, so I later installed a low shelf about 6 in. above the bottom. The TV now sets on this shelf, while the space below holds magazines and newspapers.

Three 3-ft. fluorescent lights above the three bookshelf sections provide indirect lighting for that whole end of the room. The on-off switch which controls them was mounted under the lip of the cabinet top on the extreme left.

All in all, the unit has been a complete success. Instead of clutter, we now have the rich warmth of a paneled bookcase wall that is designed to fit into and enhance the overall appearance of the room.

LIQUOR CABINET above the laminated plastic inset turns this part of the unit into a compact party bar.

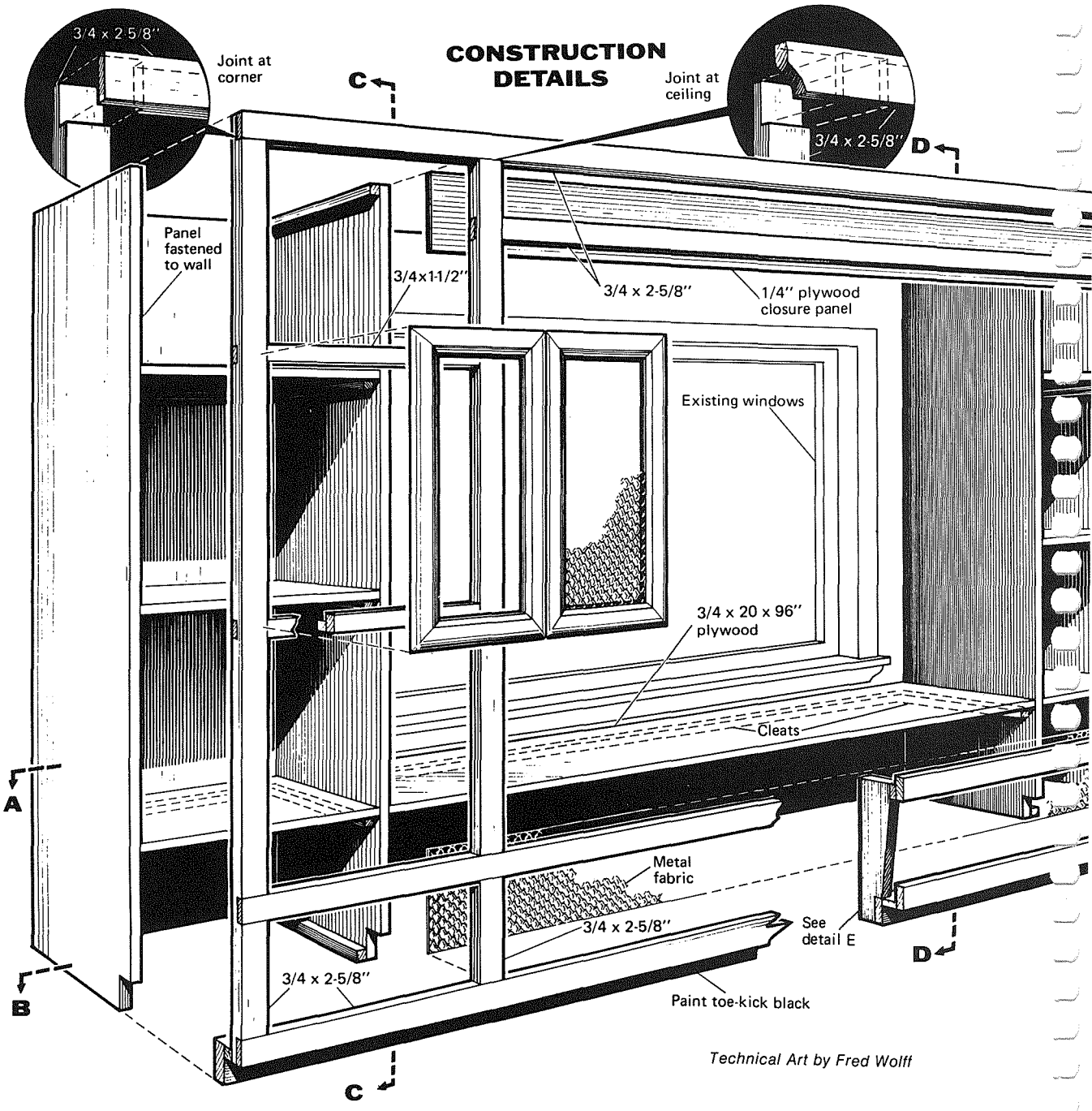



SHELF UNIT
Lighting channel projects 3-1/2" beyond shelf face
All facing pieces 3/4" walnut-veneer plywood
4-3/4"
1/4" plywood shelf backing
Black laminated-plastic inset for the bar top
7-1/2"
14"
36"
14"
CABINET
Touch latch
Piano hinge
2 x 2
29-1/2"
CABINET INTERIOR LAYOUT
4" bolts
5-1/4"
3/4" walnut-faced plywood kickboard
18"
2 x 2 frame
Cabinet
16"
2 x 2 legs
BASE
BASE PROFILE

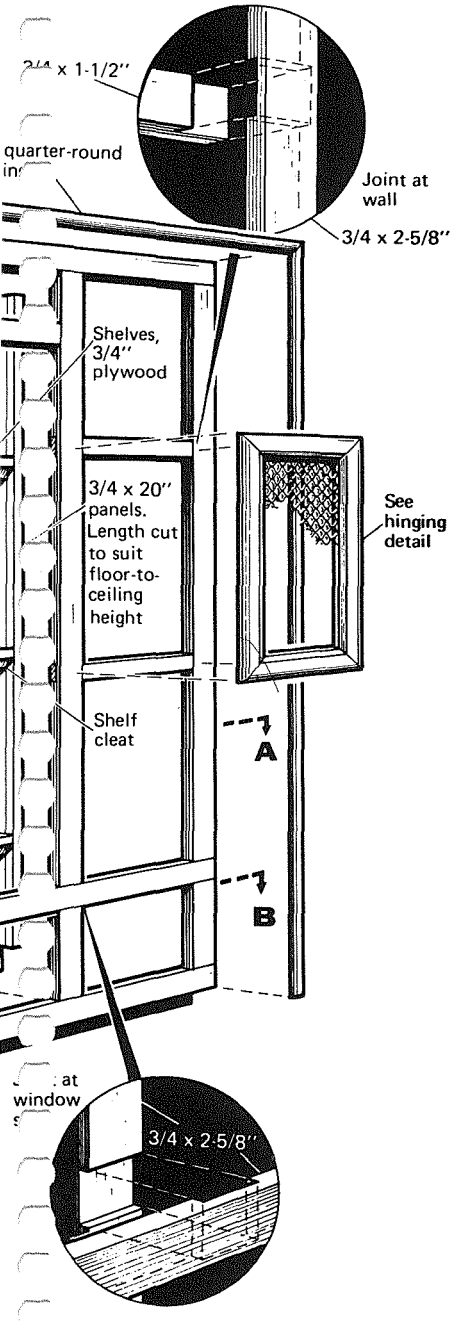
Cover a radiator and gain a storage wall

By WILLIAM E. SCHREMP

An ugly, intrusive radiator and an awkward shortage of storage make a double problem. But this handsome wall-and-window treatment solves both—and 'makes' the room in the bargain. With a few simple tips, the work isn't complicated nor the materials costly



Technical Art by Fred Wolff



■ OLDER HOMES frequently have two kinds of problems at the same time: hefty, protruding radiators that contribute a boiler-room appearance, and too little storage to handle the needs of a busy modern family. Happily, with careful planning and a little imagination, you can complete a single project that will answer both problems.

This attractive, functional wall started out as such a problem. The radiator was (and still is) beneath the double-mullion windows and—as is usually the case—it's centered on the wall. The result was wall space which left little choice when placing furniture, plus a dust-collecting heat source which was a nuisance to clean.

Since the built-in occupies one end of a dining room, the radiator enclosure was built at window-seat height from wall to wall. And the cabinets flanking the enclosures were built extra deep to provide ample storage for glassware, dishes and games used when entertaining.

The window seat, which covers the radiator, serves as an indoor garden. It's lit from above with special bulbs for growing indoor plants. And for protection against moisture, I lined this space with 12-in. ceramic tiles.

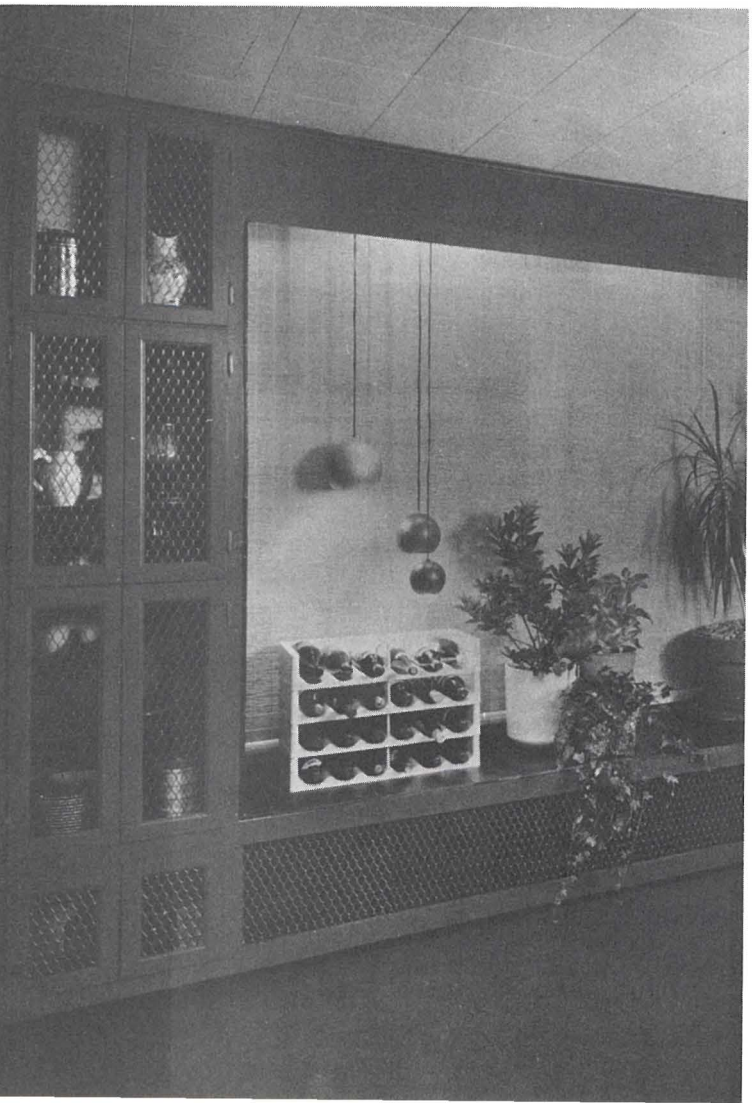
hiding the radiator

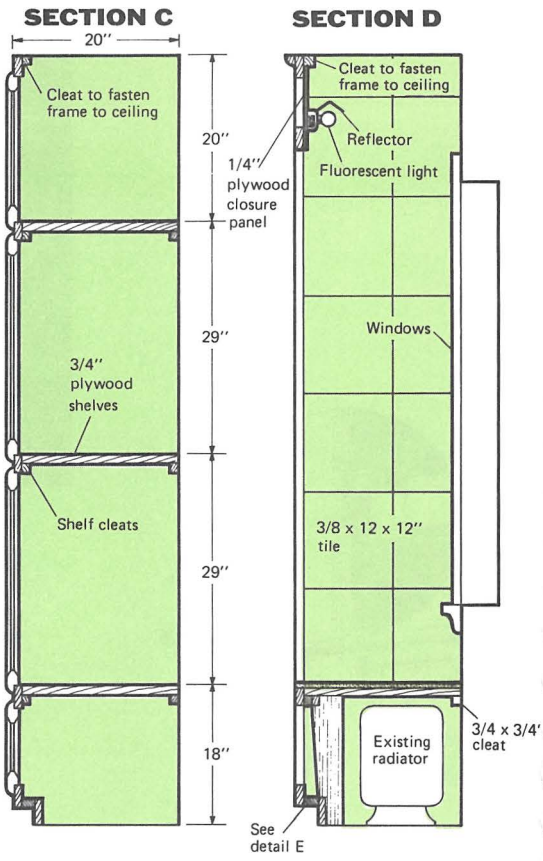
To allow free circulation of the heated air, the radiator itself must be covered with a relatively

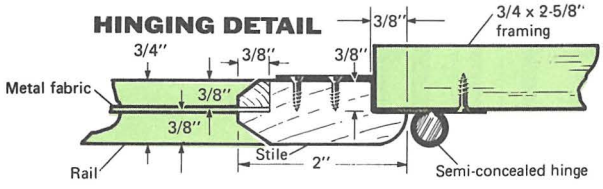
SEE ALSO
Hinges . . . Storage ideas

hide a radiator, continued

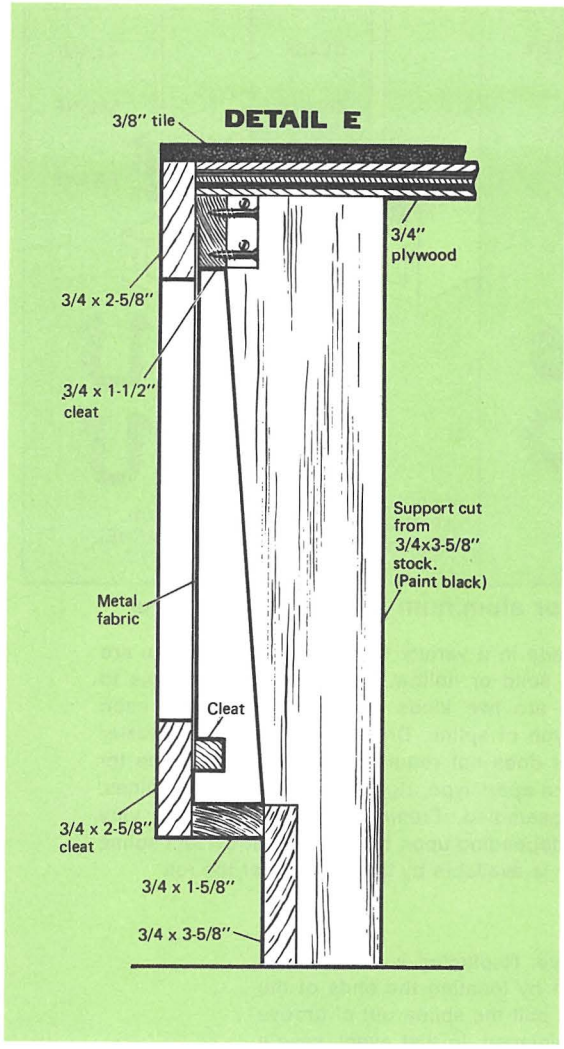
Intricate cabinet work is avoided and discarded doors from old kitchen cabinets are revised and pressed into service. The result: An ugly wall becomes a dramatic showpiece and focus of the room







THE WINDOW SEAT surface and the lowest of the shelves, as shown in these sections, are both about 18 inches off the floor. The window seat height is governed by the radiator height, of course. The hinging detail illustrates how the offset hinges are largely concealed. Close view of the project (left) shows how attractive the open grille can be. Nevertheless, with the radiator and its surroundings painted black, the area under the window seat is hidden almost completely. A reflector behind the radiator is desirable to improve the supply of heat.



open grille. Before enclosing the radiator, spray it with black paint and it will be virtually invisible behind the brass screen.

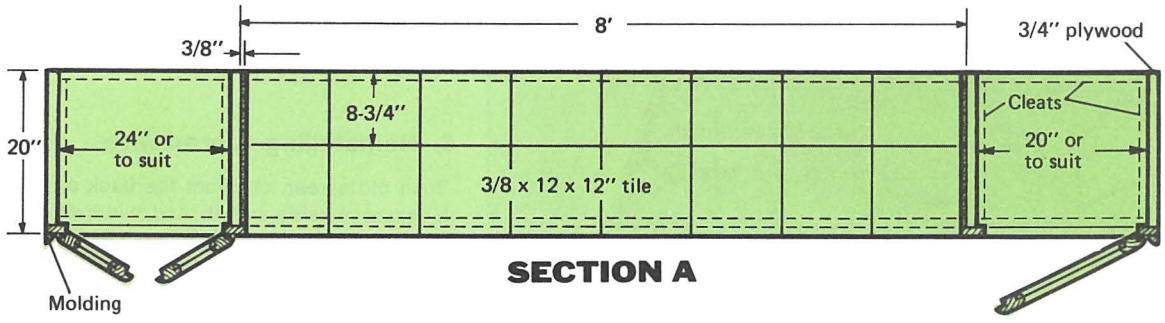
reflector helps

Line the wall behind the radiator with two layers of kitchen-type foil (or a piece of sheet aluminum). If you use the former, make certain that both layers are glued securely to the wall, or the moving, heated air will cause "crinkling" noises. The foil effectively reflects and bounces the maximum amount of heat into the room.

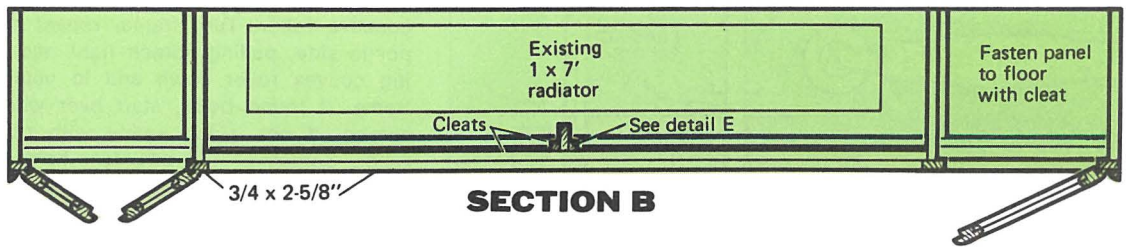
The cabinets are easy to build; no fancy or intricate cabinetry was employed here. And to make the job even easier, I utilized discarded, inexpensive kitchen-cabinet doors. Your local kitchen-cabinet contractor will gladly sell you all you need at nominal cost since any kitchen remodeling job he tackles requires removing the old cabinets anyway.

When you have your cabinet doors in hand, lay out the cabinet frame to suit the door opening sizes. The inserts are a matter of personal choice but we chose to stick with brass grille throughout. A trip to your local lumberyard will reveal an almost staggering variety of grilles and plastic inserts that are available at relatively low cost.

If you're using doors removed from old cabinets, you'll first have to remove the plywood inserts by routing a rabbet around the frames on the rear side. This will let you lift the wood inserts and replace them with decorative brass grilles.

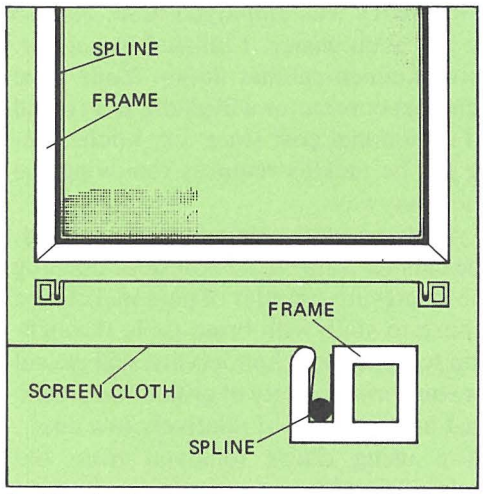


SECTION A



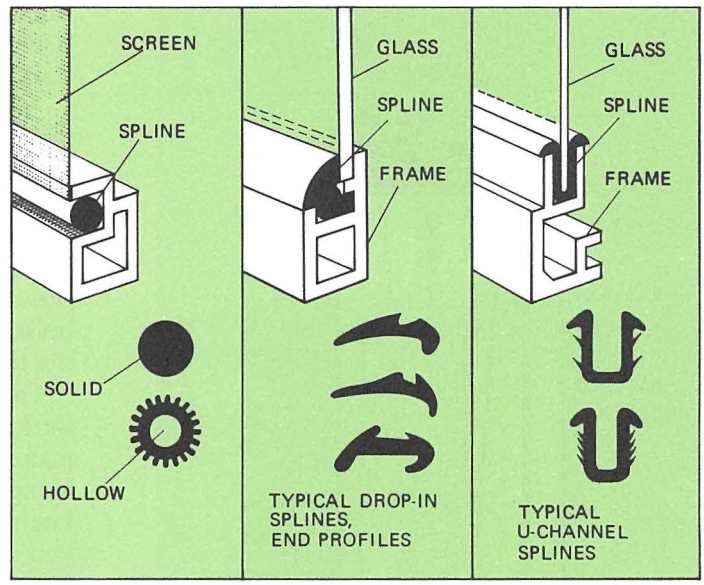
SECTION B

How to repair aluminum storms and screens



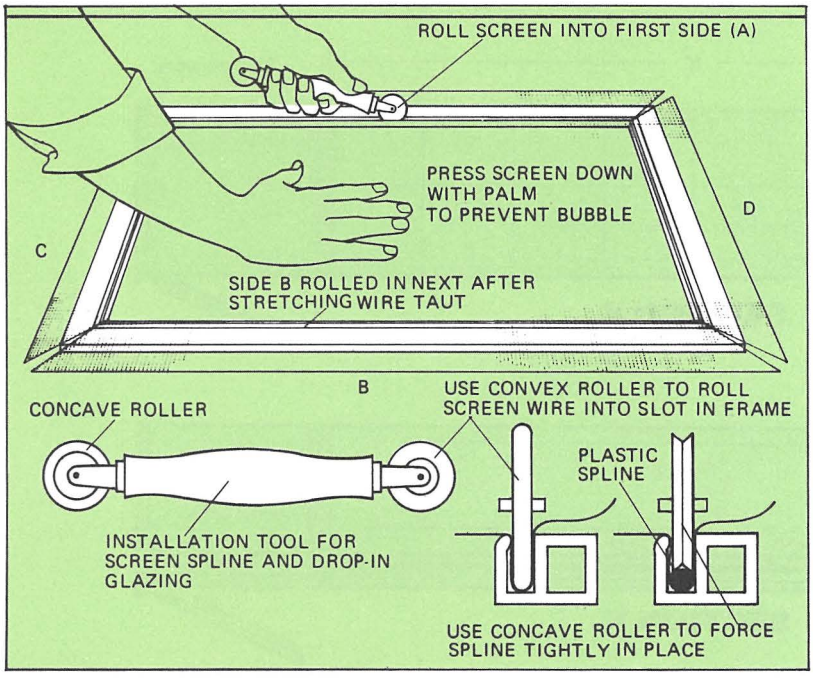
1. Typical aluminum screen

The screen cloth is secured by a plastic spline in frame groove. Replacing a torn window screen is simple if proper technique and tools are used. Begin by locating the ends of the spline in groove, lift them with an awl or screwdriver blade and pull the spline out of groove on all four sides of the frame. If the spline breaks, it must be replaced. In that event, save a sample of the old spline in order to purchase the correct replacement



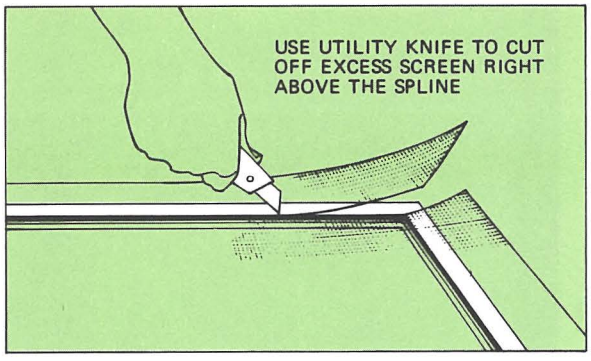
2. Splines for aluminum storms and screens

Splines are made in a variety of shapes. At left above are round splines, solid or hollow, used to secure screens to frames. There are two kinds of storm-sash frame, each with its own type of spline. Drop-in type, center, is easier to handle as it does not require disassembly of frame for re-glazing. Take-apart type, right, using U-channel splines, must be disassembled. Frame and spline designs vary considerably, depending upon the maker, but correct spline shape and size is available by the package or the roll


ROLL SCREEN INTO FIRST SIDE (A)
PRESS SCREEN DOWN WITH PALM TO PREVENT BUBBLE
C
D
SIDE B ROLLED IN NEXT AFTER STRETCHING WIRE TAUT
B
CONCAVE ROLLER
USE CONVEX ROLLER TO ROLL SCREEN WIRE INTO SLOT IN FRAME
PLASTIC SPLINE
INSTALLATION TOOL FOR SCREEN SPLINE AND DROP-IN GLAZING
USE CONCAVE ROLLER TO FORCE SPLINE TIGHTLY IN PLACE

3. Reinstalling screen wire

Push old screen out from the back of frame. Measure outside length and width of frame and cut new screen at least 2 in. over-size in all directions. Holding screen down on frame, use installation tool's convex roller to force into groove with five or six passes—don't try it with one pass or screen will rip. Place spline on groove, force it in place with concave roller. Turn frame, repeat on opposite side, pulling screen tight and working convex roller down and to outside of frame. If frame bows, start over with new screen. If not, place spline with concave roller. Screen should now feel tight. Using scissors, make V-cuts in screen at corners to relieve tension; then finish the last two sides in the same way

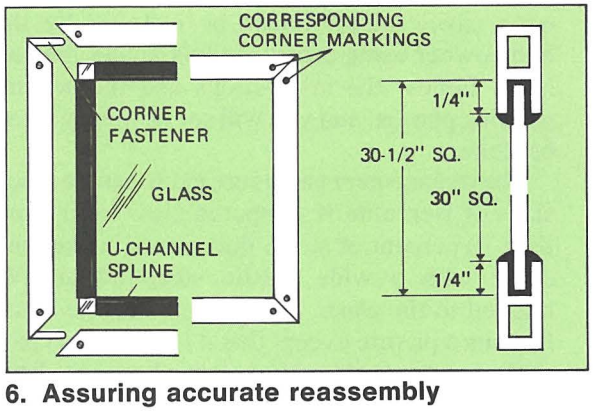


4. Trimming the wire

After screen has been grooved and locked in with spline on all four sides, insert tip of a utility knife just above spline in groove's outer side. Hold frame and run knife along inside edge. Excess screen can now be pulled away and discarded. Take care when cutting to avoid splines

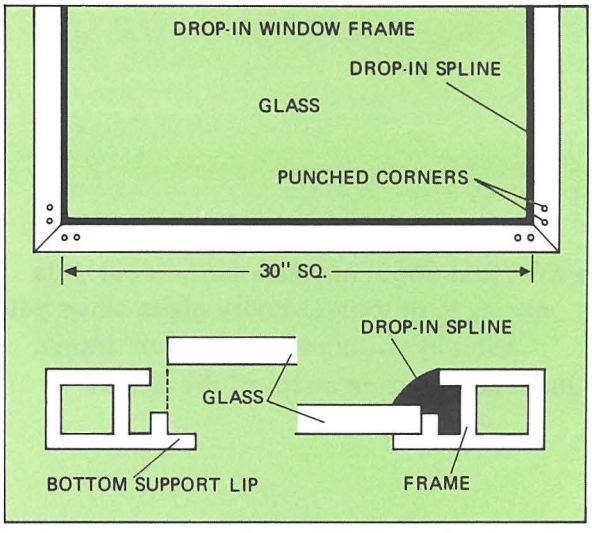
SEE ALSO

Doors . . . Glass cutting . . . Home winterizing . . . Locks, door . . . Screens . . . Sliding glass doors . . . Windows



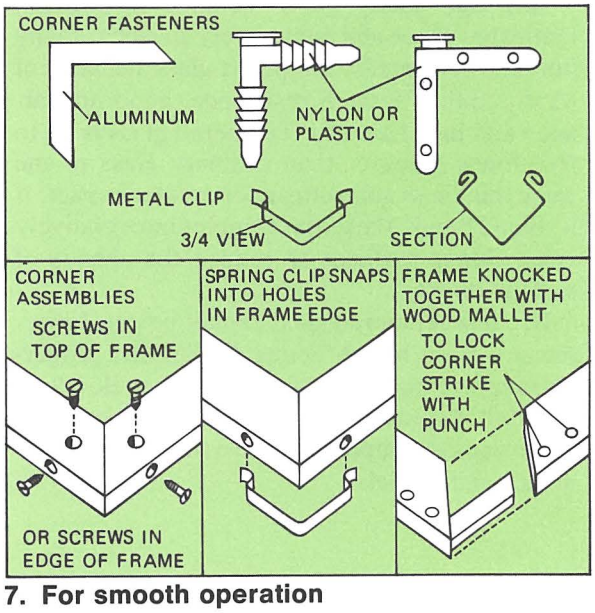
6. Assuring accurate reassembly

Take-apart frame, above, should be matched at three corners to assure accurate reassembly. For width and height of frame for glass, take distances between opposite U-channel bottoms. Be sure to allow (subtract) for spline. Fit U-channel spline over all four edges of the pane. Then using a wood or plastic mallet, gently tap on a section of the frame—one without corner fasteners—into place over the spline on the glass edge. Repeat on opposite edge, then line up frame sections to which corner fasteners are attached with corresponding holes on first two sides. After gently tapping frame together, replace corner screws or the clips as is seen at the sketch on the right



5. Reglazing aluminum storm sash

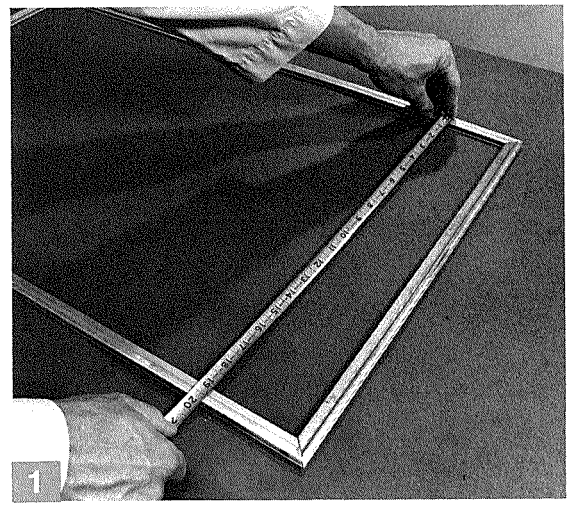
Replacement of glass in aluminum storm sash requires precaution of wearing gloves and safety goggles. To remove glued-in glass, brush the pieces with paint remover; save a scrap piece to assure you buy the right thickness for your replacement pane. Frame above, a drop-in type, does not come apart. Measure inside dimensions including support lips. Cut window glass to size and carefully lay it inside the frame so that it rests on the lips. Insert drop-in spline by laying it on the window beveled side up and pushing it into the frame with your fingers. Repeat the procedure for the other three sides and the window is finished. Here, too, if the old spline breaks, replace it with a new one



7. For smooth operation

Keep window tracks clean and spray with silicone lubricant. A mild cleaner and water will remove discoloration; avoid using abrasives

This unique tempered-glass insert is made to fit just about any size storm door. It is easier to fit than ordinary glass since you are actually cutting a plastic 'mat' frame. Just score it, then snap off the plastic



FIRST, MEASURE the inside length and width of the old storm-door glass frame to determine the overall size of the replacement to fit the frame.

Tempered-glass inserts make storm doors safer

REPLACING ORDINARY glass in storm doors with safety glass is an increasing concern of homeowners aware of the injury potential if a child runs into the glass or an adult accidentally falls against it.

Although safety glass includes wire glass, laminated glass and rigid safety plastics, many homeowners prefer tempered glass because of its durability, scratch resistance, good appearance and high strength. Tempered glass is up to five times stronger than ordinary glass of the same thickness and withstands greater impact. If it should break, the glass crumbles into relatively small, blunt particles to reduce the chance of serious injury.

Because tempered glass cannot be cut, homeowners often had difficulty finding the proper-size replacement panel for their storm doors. A distributor would have to stock as many as 750 or more sizes of tempered glass to fit all storm-door makes and models.

PPG Industries manufactures a tempered safety-glass replacement panel adaptable to most storm doors. It can be installed by the homeowner using ordinary tools in less than an hour. Follow the instructions and the accompanying photos, and you will see how easy it can be done.

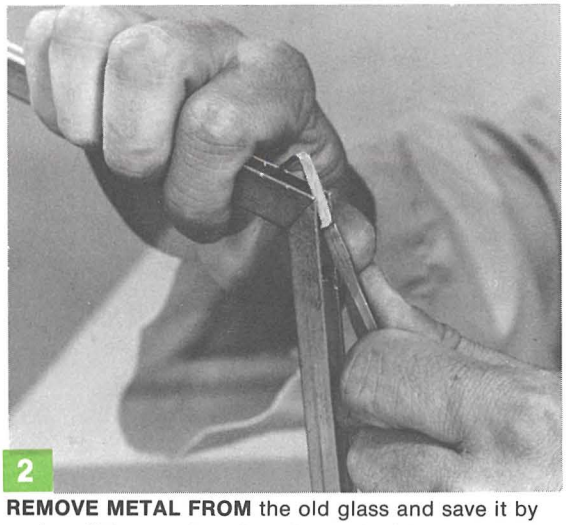
The replacement panels are made in nine stock sizes of Herculite K tempered glass to fit more than 70 percent of storm doors now in use, and come with a wide plastic surround already bonded to the glass. The surround is like a mat framing a picture except that it is an integral part of the tempered glass. The plastic has score lines at ⅛-in. increments for easy cutting, and each edge can be trimmed up to 1½ in. Replacement panel dimensions thus can be varied as much as 3 in., both in length and width. In this way they can be made to fit almost any storm door.

Tempered-glass replacement panels currently are being produced in the following inch sizes: 18x26, 21x29, 21x32, 29x27, 29x30, 30x32, 27x38, 30x38 and 32x41. As an example of size flexibility, the 3-in. trim allows the 18x26-in. tempered-glass unit to accommodate, in ⅛ in. increments, panel sizes as small as 15x23 in.

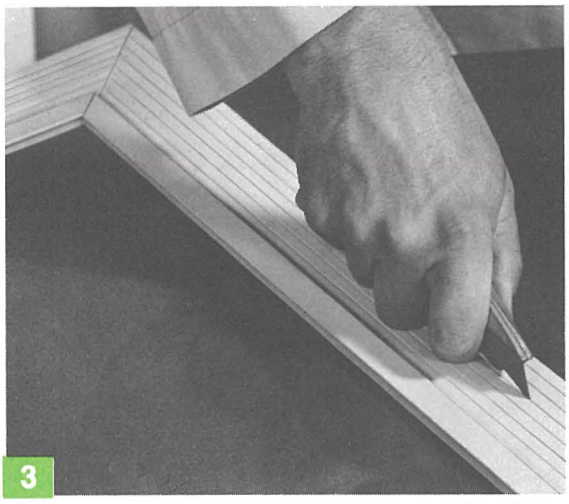
Panels are available through glass distributors and shops specializing in storm doors.

SEE ALSO

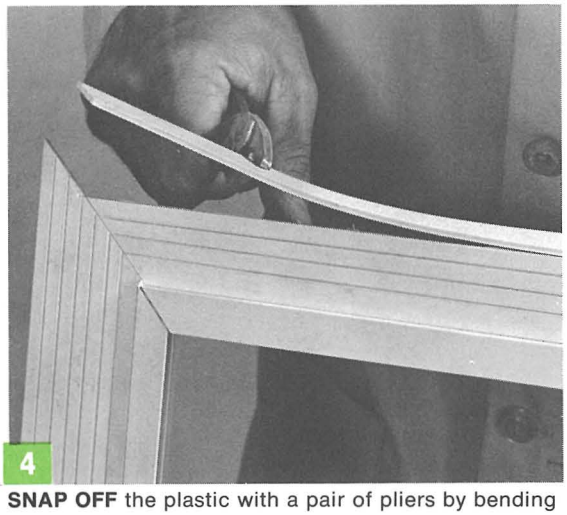
Doors . . . Glass cutting . . . Home winterizing . . . Locks, doors . . . Sliding glass doors . . . Windows



REMOVE METAL FROM the old glass and save it by prying off the metal clip found at each of the corners. This is done with a screwdriver blade.

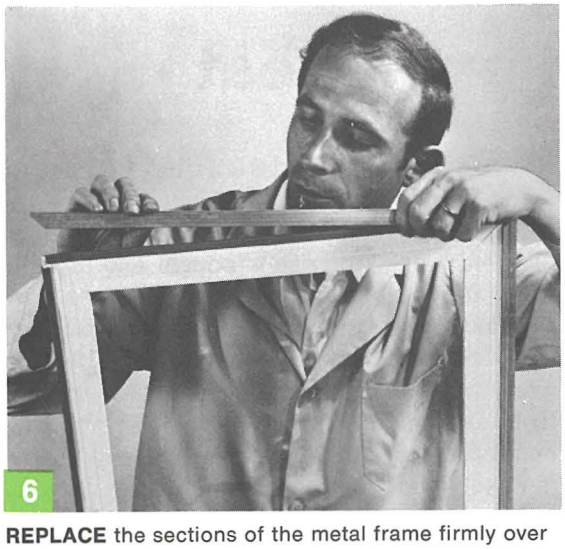


USE THE SPACED ⅛-in. grooves that are provided in the plastic frame bonded to edges of safety glass as guide lines for scoring with a utility knife.

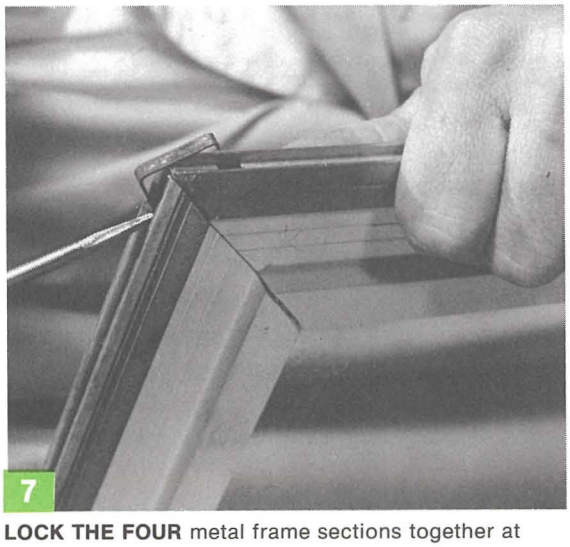


SNAP OFF the plastic with a pair of pliers by bending along the knife score. You bend along the full length of the plastic score to break it off.

REINSTALL the original rubber gasket that was taken from the old storm glass. It is placed over the edges of the new plastic frame.



REPLACE the sections of the metal frame firmly over the gasket surrounding the plastic frame in exactly the same manner as they were originally held.



LOCK THE FOUR metal frame sections together at the corners as a final step. This is accomplished by carefully reinserting the original clips.

Wood-burning stoves— and fireplaces— add extra heat

By ELLIOTT H. McCLEARY

Paying too much for gas, oil or electric heat? As a supplement, try an updated version of your forefathers' great old wood-burner

SEE ALSO

Family rooms . . . Fireplaces . . . Firewood . . . Firewood sheds . . . Furnaces . . . Heating systems, home

THE ENERGY CRUNCH has brought the wood burner back into the American home.

In a recent year, spurred by the soaring prices of fossil fuels, Americans bought and installed 500,000 wood-burning stoves. In response to the demand, manufacturers here and abroad have enlarged their lines to include a wide range of everything from old-time pot-belly stoves built from original designs to sleek prefabricated metal fireplaces that the homeowner can install in a weekend, complete with chimney.

There are also elegant free-standing Franklin fireplaces with doors that are opened or removed to give you a full view of the dancing flames. Plus

wood-burners you can team with your present gas or oil furnace to supplement its heat and backstop it in emergencies; and even wood-burning cookstoves and water heaters.

Although firewood can be costly, especially in large cities, it is available in many places free for the cutting—from fallen trees on neighbors' lawns, limbs felled by utility companies, to deadwood gathered by permission from specified areas of state and national forests. All you need is a chain saw and a means of hauling, both of which can be rented.

For many, a big attraction of burning wood for fuel is because it's so "natural"—and ecologically sound. Compared with fossil fuels, wood is virtually nonpolluting and is infinitely renewable. There are 750 million acres of U.S. forest—more than three acres for every American—and much potential firewood simply goes to waste.

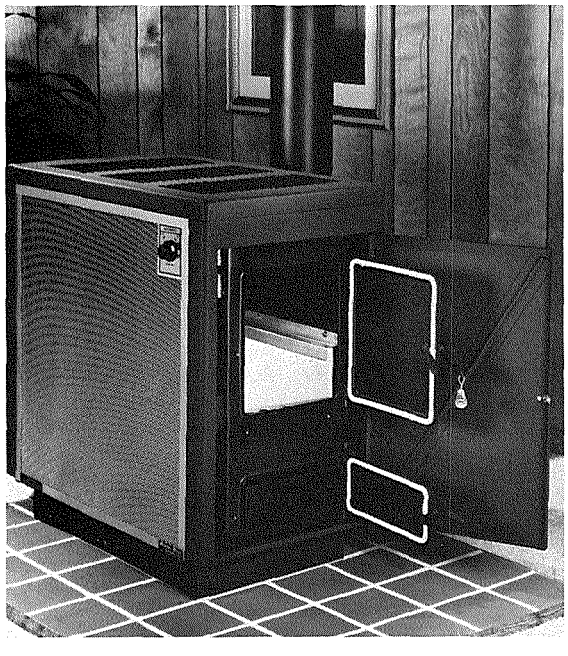
Fireplaces have always been popular for reasons other than economy—for atmosphere and coziness, leaping flames, glowing embers and wood-smoke fragrance. But from the standpoint of efficiency, the conventional fireplace is a loser—90 percent of the heat goes up the chimney.

The half-fireplace, half-stove invented by and named after Benjamin Franklin is about 25 percent efficient; its cast-iron surfaces hold and radiate heat out into the room. Far more efficient are modern wood-burners, built with tight fireboxes, pre-heater air passages and baffle systems to retain heat and promote the ignition of burnable gases; these stoves attain efficiencies up to 60 percent and more. Some are equipped with non-electric bimetal thermostats that automatically adjust air intake to maintain a pre-set temperature level, and some will hold a hardwood fire for 12 to 14 hours at a time. An added advantage of stoves over fireplaces is that you can cook, heat a teakettle, and dry mittens on their flat tops.

Lightweight prefabricated metal chimneys, triple-insulated, make it possible for the do-it-yourselfer to install a stove or fireplace in practically any room of the house. In the absence of an existing nearby chimney, the wood burner can be vented through a factory-built metal stack that passes through floors and roof. The stack should rise at least two feet above any roof within ten feet (see diagram), with firestop spacers and extra bracing emplaced where the pipe passes through floors and roof. (Make sure that the chimney is Type A [for solid fuel], Underwriters Laboratories listed, and meets the specifications of the stove manufacturer and the local building code.)

If an existing masonry chimney is to be used, it must first be checked for soundness, and for cracks or holes that would permit sparks to exit. The chimney should have an intact liner and be

WONDERWOOD CIRCULATOR HEATER provides heat for 10 hours or more, for several rooms, with just one load of hardwood logs. Blower is optional.



IDEAL FOR a mountain cabin, the Sheep Rancher provides low-cost heat and cooking. It is a replica of stoves used on the western range.

cleaned annually to prevent chimney fires. The stove should be placed so that the stove pipe is as short as possible, without unnecessary elbows. If an asbestos or insulated sheet-metal heat shield is fastened to the wall, the stove may be set within six inches of the wall; otherwise it must be at least 30 inches away from any combustible surface. In addition, the stove must rest on a heat shield or hearth that extends out far enough to catch the occasional fallen ember.

many types; take your pick

Each type of wood burner has its particular advantages. The *Franklin stove,* available from various manufacturers, provides a dramatic open hearth as large as many fireplaces, in which you can burn sizable logs.

The Franklin also provides a large top surface for cooking, and one model by United States Stove Co. (South Pittsburg, TN 37380) even includes swing-out grill for barbecuing. Charcoal can also be burned in a Franklin; or it can be provided with a gas log to produce a realistic fire when you don't feel like splitting wood (Incidentally, it's now possible to buy an automatic log splitter).

Some Franklins available today, such as those manufactured by Fawcett (Enheat Limited, Sackville, New Brunswick, Canada) are faithful copies of originals designed a century and more ago. Others, such as the Americana by Autocrat (New Athens, IL 62264) have an old-fashioned exterior but include hidden improvements such as baffles, thermostatic controls and even optional blowers to increase efficiency when the front doors are shut.

Akin to the latter version are the popular Defiant and Vigilant "parlor stoves" of Vermont Castings (Box 126 Prince Street, Randolph VT 05060) which have a swing-open front hearth like a Franklin but an interior design with long flame paths and a complex baffle system to improve combustion.

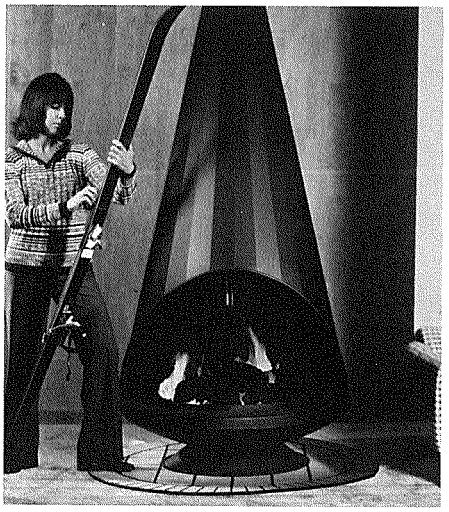
rugged old-timers

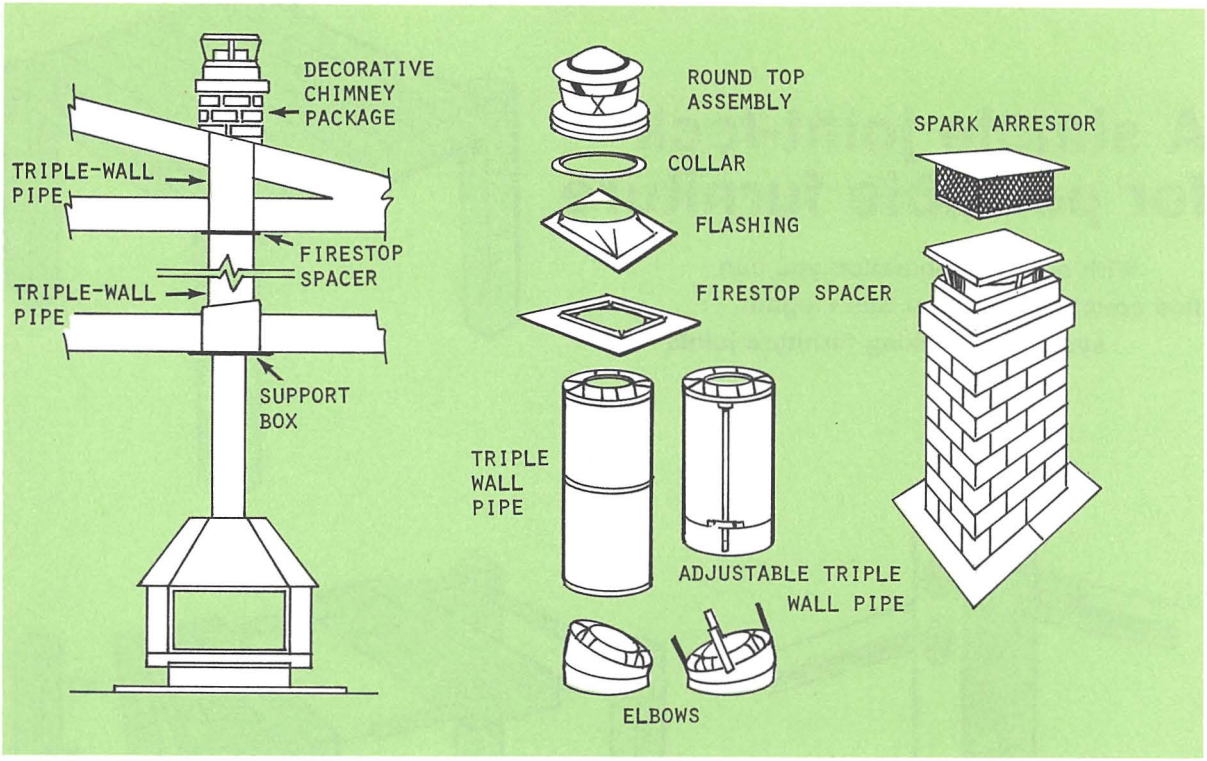
The pot-belly stove made by Hearth Craft (P.O. Box 20584, 10035 NE Sandy Blvd., Portland, OR 97220) and others is just one of a whole family of authentic wood burners out of your favorite Western movies. The pot-belly was the model T of wood burners—ugly but functional, highly efficient, space-saving, easy to fill from the top or front and capable of burning wood, coal or charcoal. Hearth Craft also produces the compact low-slung boxwood heater, which takes several 24-inch logs and has two six-inch cooking lids on top; a large ornate "parlor stove;" and a tall, elegant "comfort stove." Like the pot-belly, all are made of heat-holding cast iron. The Sheep Rancher by U.S. Stove is a miniature range with a cast-iron cooking top and oven, said to be an authentic replica of the stove that was carried across the West in covered wagons.

Well-made, efficient Scandinavian imports, such as those of Norway's Jotul (imported by Kristia Associates, Box 1118, Portland, ME) are among the most decorative of wood-burning stoves. Forest scenes and figures of animals and humans appear in cast-iron bas relief.

Some of the oldest continuous manufacturers of wood burners adhere to modern or no-non-

VIGILANT PARLOR STOVE, left, has a swing-open hearth. Doors seal to create an airtight firebox. Jotul stove, made in Norway, heats large areas and takes logs up to two feet long. Right, Malm Fire Duke, a free-standing sheet-metal cone, is a favorite in ski lodges.





PREFAB CHIMNEY SYSTEM permits you to install your own stove or fireplace.

sense functional designs ranging in size from the squat cylindrical Carolinian by Ashley (P.O. Box 128, Florence, AL 35630), which heats 1 to 3 rooms, and U.S. Stove's sleek, boxlike Wonderwood room heaters, up to large multi-fuel furnaces built by Riteway (P.O. Box 6, Harrisonburg, VA 22801). In the latter, wood or coal and either oil or gas may be burned in the same combustion chamber. If the wood fire burns low in the middle of the night, the thermostat kicks in the auxiliary burner. In an electric power or fossil-fuel outage, you can warm the house with wood. Riteway and other manufacturers such as Monarch (Beaver Dam, WI 53916) also make small wood-burning heaters and furnaces which can be ducted into the existing warm-air heating system (a separate chimney is required). In an emergency when your oil or gas furnace is not working, heated air from the wood burner will rise and circulate through the ducts, providing some warmth for occupants and preventing plumbing freeze-ups.

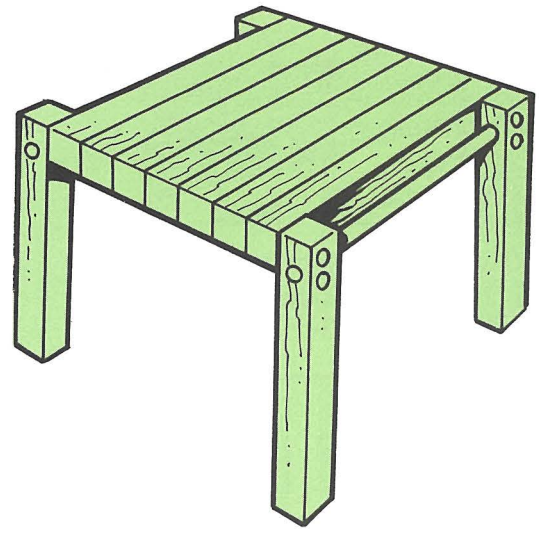
easy-to-install fireplaces

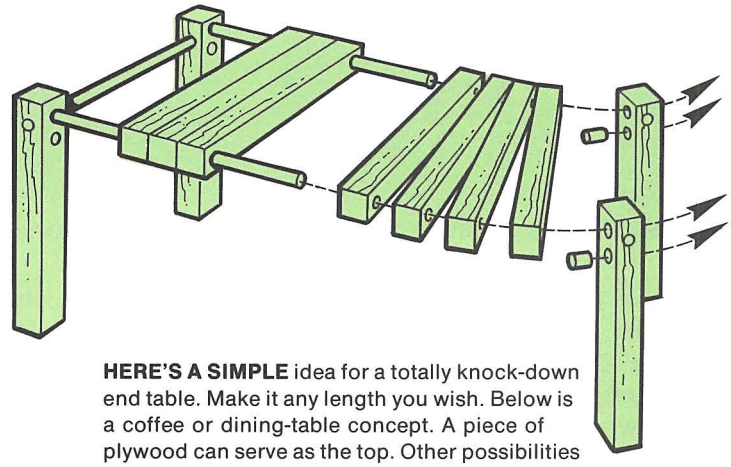
Despite the practical advantages of stoves, many people will still opt for a fireplace. Fortunately some of these are as easy to install as a stove. Perhaps the easiest are the free-standing lightweight (100 to 200 pounds) metal units such as the Hearth Craft Firecone or the LaSalle by Martin (P.O. Box 128, Florence, AL 35630). Typically, these are black or bright-colored porcelain-enameled steel cones set above a ceramic saucer hearth, vented up through a prefabricated metal chimney. Circular carousel units by Malm (368 Yolanda Ave., Santa Rosa CA 95404) are glass-enclosed and can be located in the center of a room. The same precautions must be observed as when setting up a wood-burning stove, except that a minimum clearance of 36 inches from combustible surfaces is required for some units. The fireplace, like a stove, must rest on a thick non-combustible floor covering or hearth. As with a wood-burning stove, the room should not be too tight; it's possible for a fire to burn up all the oxygen in a room—a real danger in today's super-insulated homes—so open a window or door a bit.

Lightweight metal fireplaces are also available for built-in placement without the use of masonry. The effect is that of a conventional fireplace at a huge saving in cost and time. Fully insulated at the factory, the pre-assembled fireplace is safely installed directly on and against wooden floors and walls. The flue is vented through a metal smokestack, which may be topped off with a lightweight shell that looks like a real brick chimney.

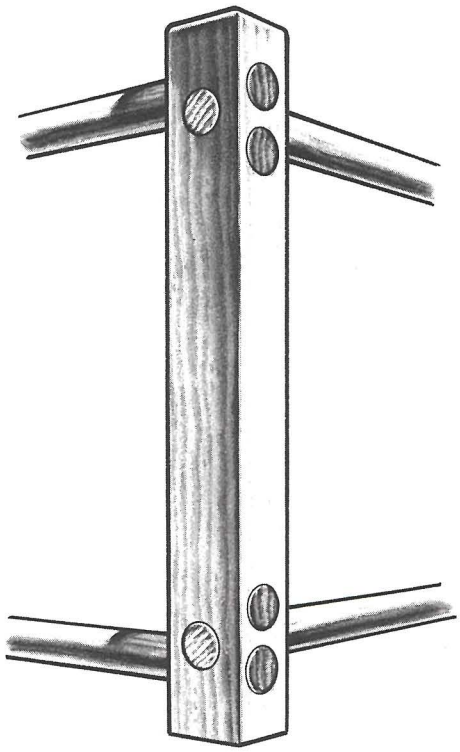
A simple joint-lock for portable furniture

With a little imagination you can find countless uses for this elegant system for making furniture joints



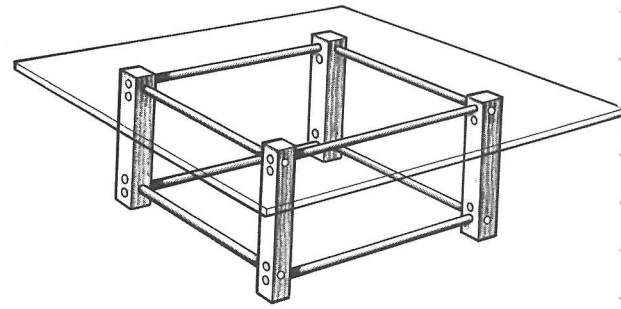


HERE'S A SIMPLE idea for a totally knock-down end table. Make it any length you wish. Below is a coffee or dining-table concept. A piece of plywood can serve as the top. Other possibilities for use of the peg-lock system include bookshelves, beds, couches, and even children's playhouses.

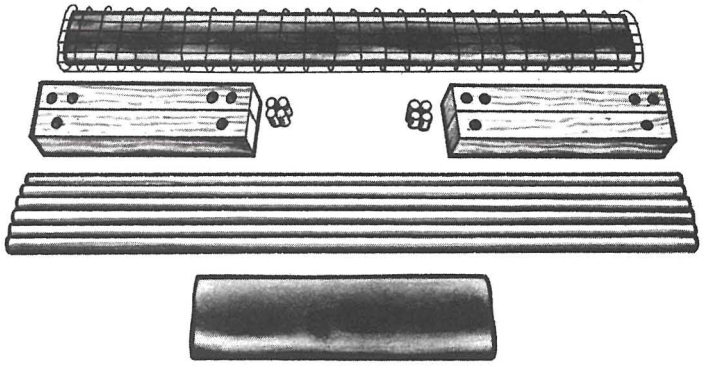


THE PEG LOCK is attractive, yet simple to build. All you see are the smoothed ends of three dowels. To disassemble furniture you punch out locking peg, and pull joint apart.

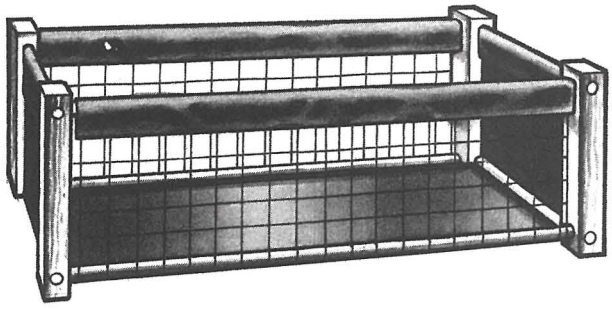
■ HERE'S AN ELEGANT system for solidly locking the joints of knock-down furniture. Invented by Jim Hennessey, the system is extremely simple, and lends itself to countless applications. Study the drawing on the bottom of the opposite page. You drill hole A and insert a

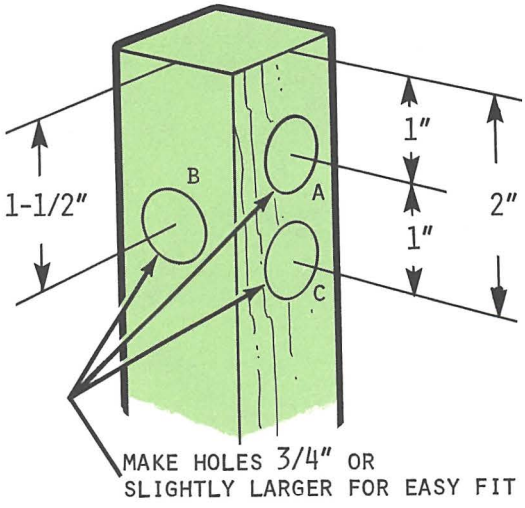


Adapted from *Nomadic Furniture* and *Nomadic Furniture 2* by Victor Papanek and James Hennessey. Copyright 1973 by Victor Papanek and James Hennessey. Reprinted by permission of Pantheon Books, a Division of Random House, Inc.

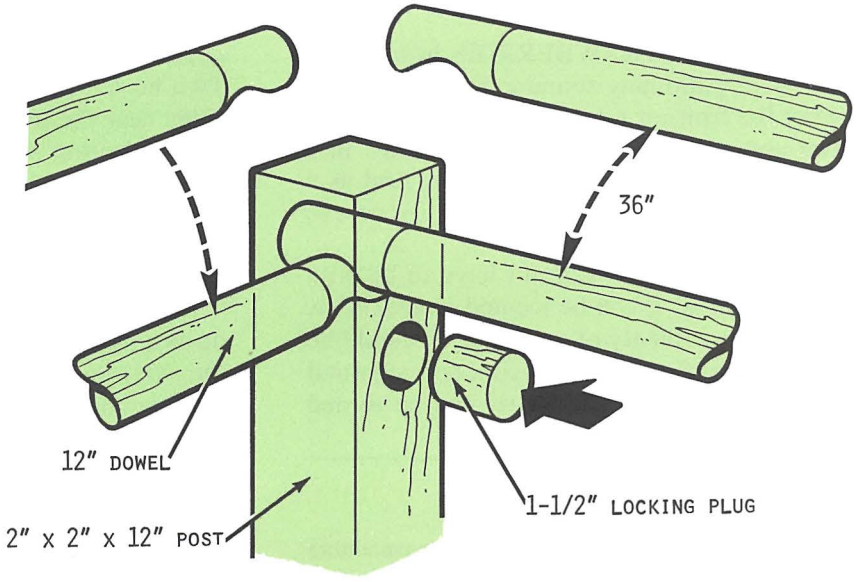


KNOCK-DOWN BABY BED consists of ¾-in. dowels, 2 x 2 uprights, a sailcloth bottom and ends, and pieces of volleyball net for the sides. Drill holes and insert dowels one at a time, making the holes just slightly oversize (or sand the dowels) so the dowels will slip into place easily. No matter what your project, key-mark the parts so you can always assemble them the same way.





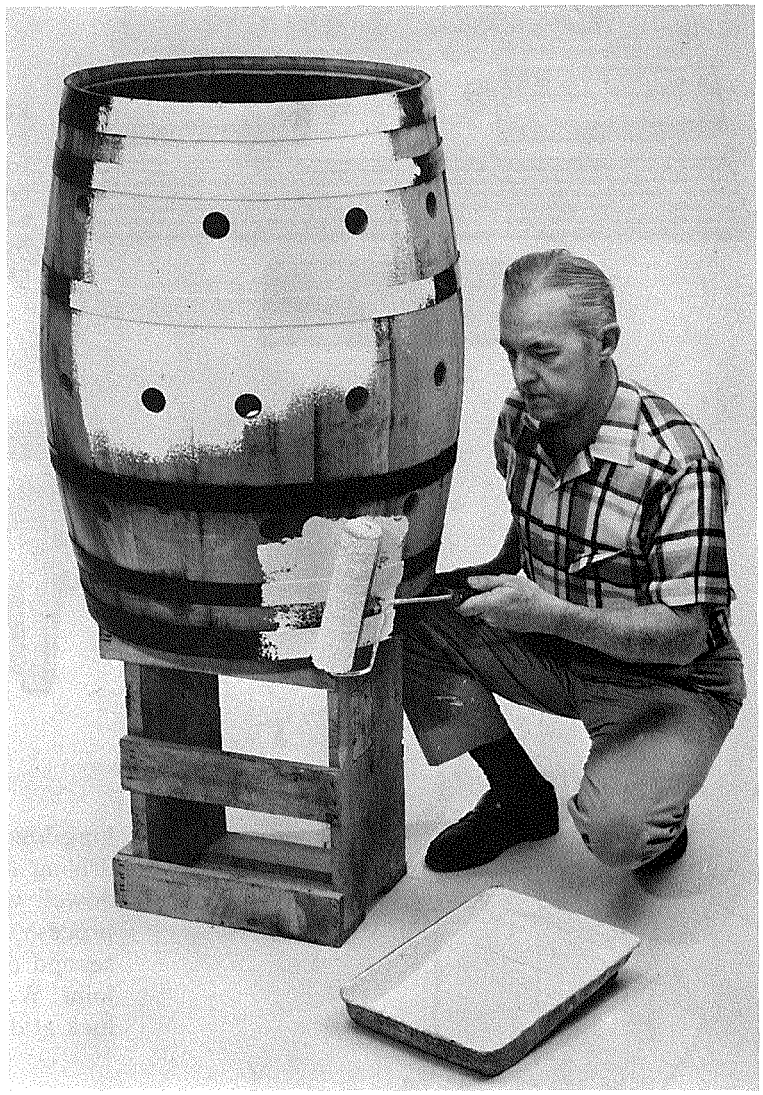
long dowel. Then drill hole B at a right angle, also drilling away part of the dowel. Insert a second dowel, which locks the first. Then repeat the process with hole C, inserting a plug to lock the second dowel. Presto—a solid, yet take-apart joint! We show a few potential uses. Try your luck at designing more.



Strawberries by the barrel

By WAYNE C. LECKEY

Grow strawberries in a barrel? Why not? The barrel keeps them off the ground so they grow faster and cleaner. This one's even equipped with wheels, so the strawberries follow the sun! Just follow these simple directions for a bumper crop



AN OLD BARREL can be painted, a new one stained and varnished. Treat the inside with wood preservative.

PLUCKING STRAWBERRIES from a barrel on your patio may sound crazy, but what a treat! Like fruit on a bush, berries grown in a barrel are a lot cleaner than when grown in a strawberry patch—and a lot handier. And as a center of attraction, a strawberry barrel is sure to make conversation.

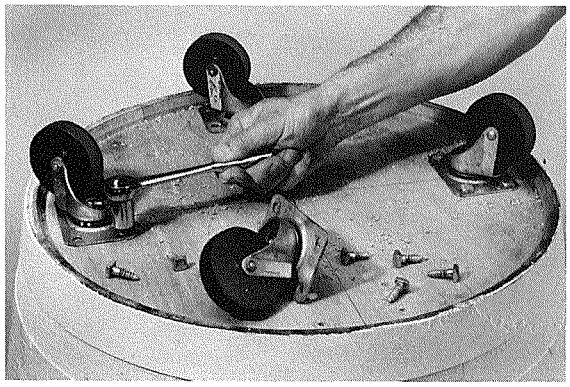
A strawberry barrel doesn't have to be on a patio, of course. It can be located anywhere as long as there is plenty of sunshine. It should be placed, however, on a level concrete slab and fitted with casters so the barrel can be turned occasionally to expose all plants to direct sun. Two husky chest handles attached to opposite sides near the top will facilitate turning it.

Everbearing varieties of strawberry plants, considered best suited for barrel growing, produce fruit from 60 to 90 days after planting. Strawberries can be planted as soon as danger of frost has passed.

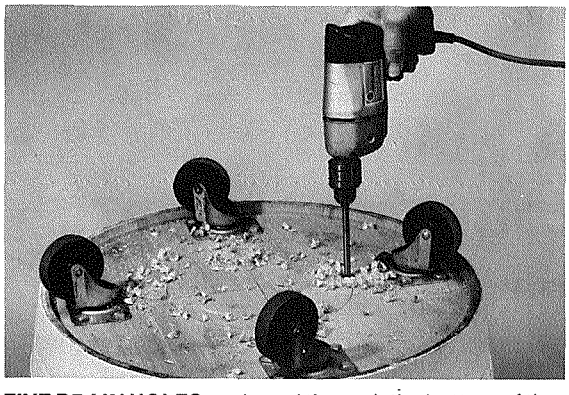
Any 50-gal. wooden barrel, new or used, will do as long as it has a good solid bottom. Holes in the side should be 1½ in. in diameter and 6 in. apart in 4 or 5 rows. You can bore 8 to 9 holes per row, which will provide for 32 to 45 plants, plus 10 more on top. The rows should be reasonably even on a horizontal plane and staggered vertically. A hole saw in an electric drill will bore the holes quickly.

SEE ALSO
Decks . . . Garden shelters . . . Gardening . . . House plants . . . Patios . . . Planters . . . Transplanting

PLANTS ARE WATERED through a perforated pipe in the center. Rows of holes let water seep out.



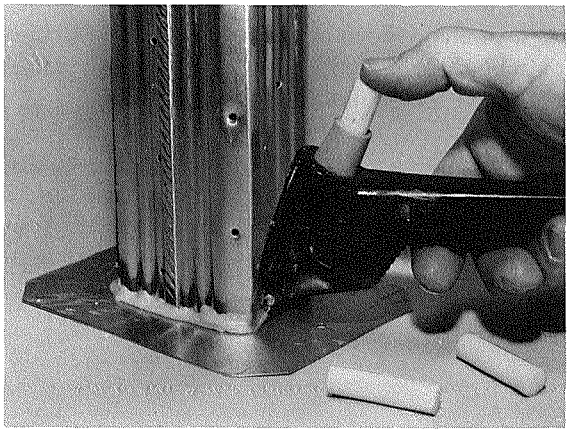
FOUR TRUCK CASTERS are attached securely to the bottom of the barrel with short lagscrews or bolts.



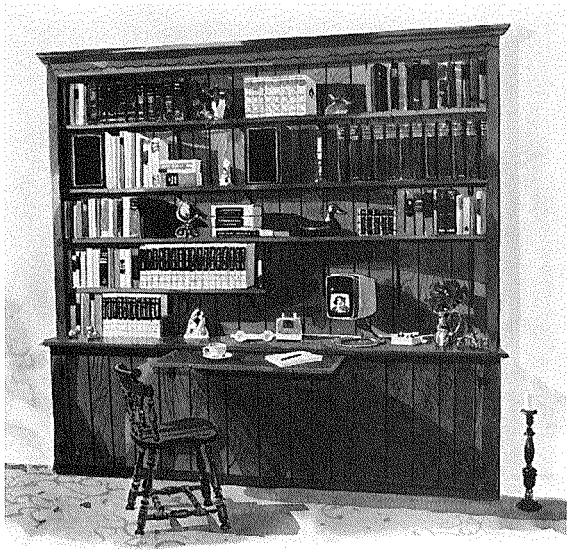
FIVE DRAIN HOLES are bored through the bottom of the barrel and later covered with broken clay pots.

The plants are watered through a standpipe placed in the center of the barrel. It's a section of common aluminum downspout cut to stand an inch or so above the top of the barrel. One end is closed and rows of small holes are drilled at random along its length. When in place, the pipe is filled with vermiculite or coarse gravel to allow the water to seep slowly out the holes. When filled, the barrel will weigh a good 500 lbs. so use heavy-duty swivel-type truck casters to support it.

Use a soil mixture of well-rotted cow manure, garden loam and sand—1/5 each of sand and manure by volume and the balance loam. Place a layer of broken clay flowerpots in the bottom of the barrel first. Then start adding the soil mixture up to the first row of holes and water to firm it. Now carefully insert the plants in the holes, spread the roots, fill with more soil and wet down gently. Continue until all the holes are planted. The plants in the top of the barrel are spaced about 4 in. apart. After the plants are established and actively growing, they can be forced to grow more rapidly by adding nutrients to the water. Watch, of course, that you don't overwater. When berries start to ripen, you may have to cover your barrel with cloth netting to keep the birds from eating them. This can be in the form of a lift-off cage made of wood strips with the netting stapled to it.



THE STANDPIPE IS CLOSED at the bottom with an aluminum scrap "welded" to the pipe with a glue gun.



A built-in learning center

By DAVID WARREN

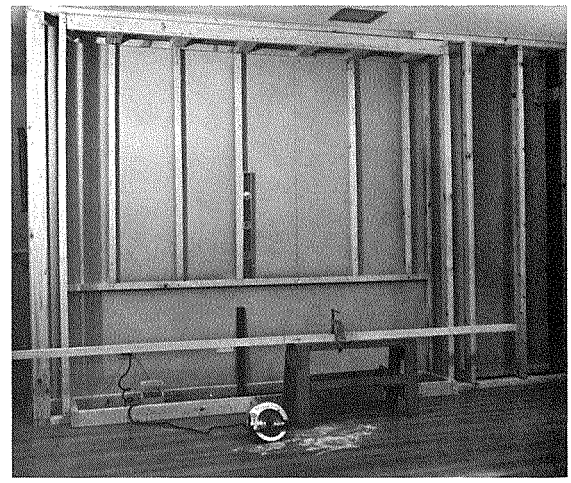
Inspired by the new learning technology that is now available as well as that which probably will be available in the future, this study center takes advantage of maximum space in a small area. You can use some of the ideas and then adapt the center to fit your home and needs

NOWADAYS, when my son, Dave, gets home from school, like most teen-agers he heads for the telephone. But, unlike most of his pals, he uses a Touch-Tone phone to call his school computer to listen to a lecture that was given earlier in the day. In the near future (I hope), a Picturephone will join the Touch Tone and give *visual* access to the school computer as well.

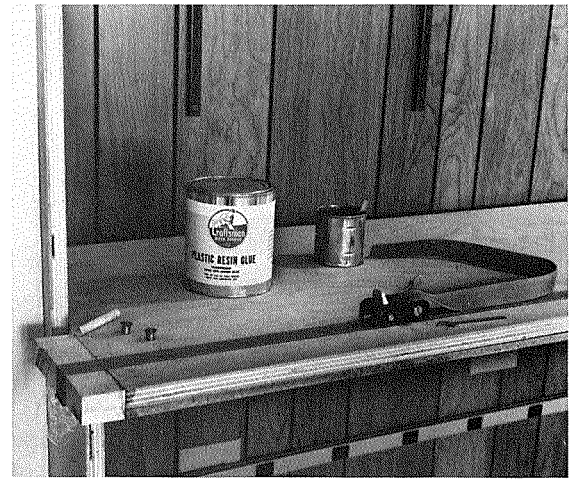
The whole concept of what is coming in educational techniques prompted the project you see on these pages. Today, schools circulate books from their libraries. In the not-too-distant future, video cassette cartridges for use on home tele-

SEE ALSO

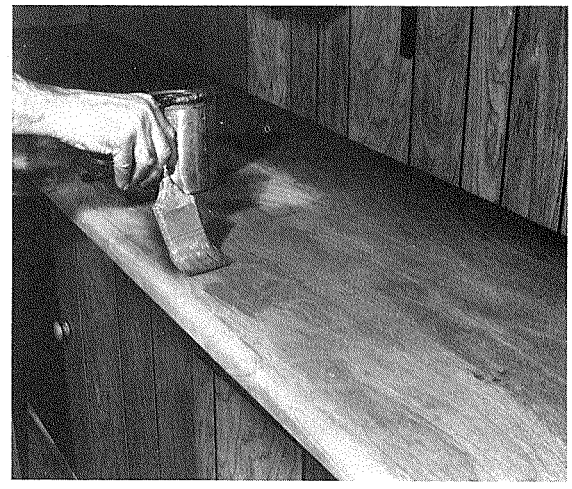
Cabinet furniture . . . Children's furniture . . . Desks . . . Sewing centers . . . Shelves . . . Storage walls



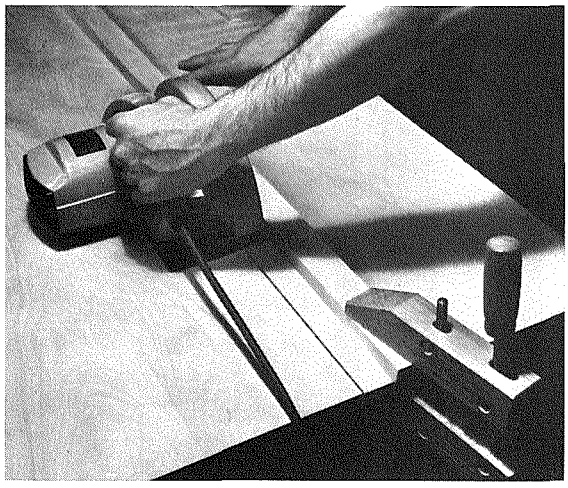
FIRST STEPS: Determine the size of the built-in; rip out the existing wall and install new framing.



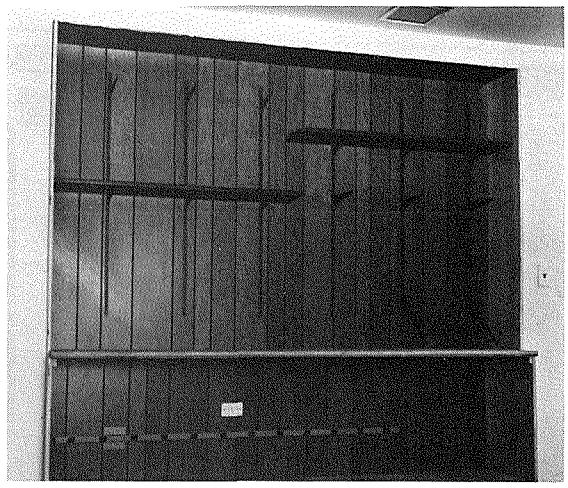
MAKE CUTOUTS for TV and electrical receptacles before placing bottom panel. Plugmold strip is shown.



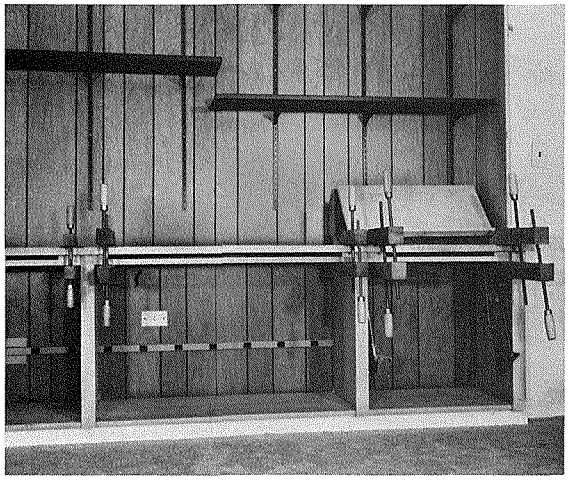
TO MATCH PANELING, author used glaze stain to finish the deck. If preferred, you could use laminate.



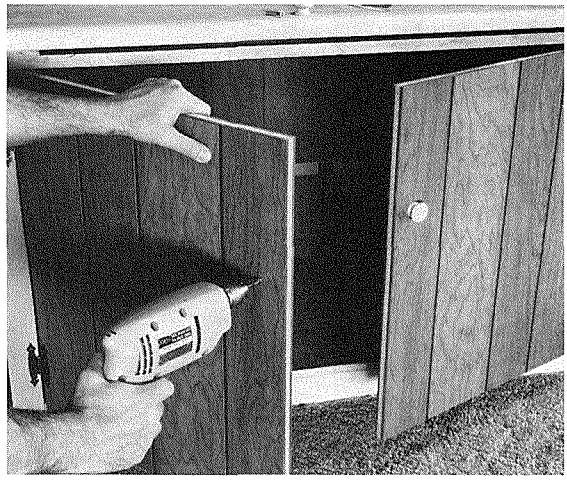
FOR TRUE panel cuts, clamp a straightedge to the plywood for the circular saw shoe to ride against.



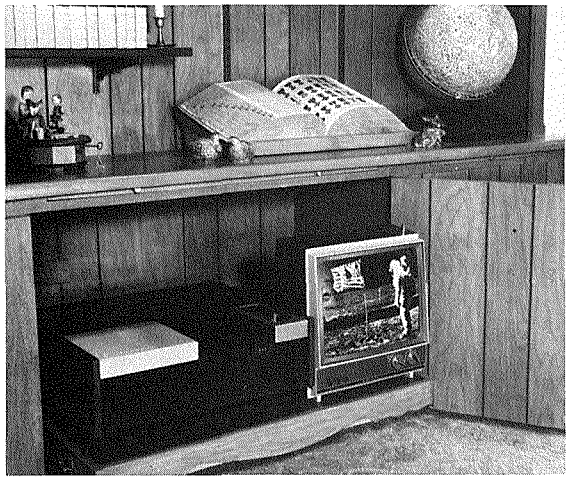
AFTER THE BACK wall is paneled, you can install the shelf standards in the upper portion of the cabinet.



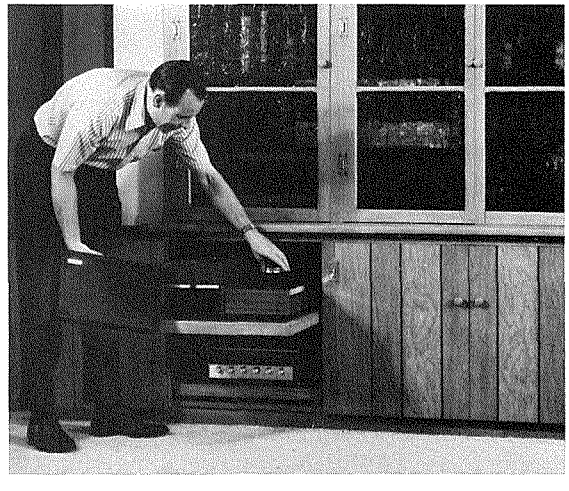
WITH THE COUNTER installed, cut out the three pieces forming the pullout-pocket frame and glue them in place.



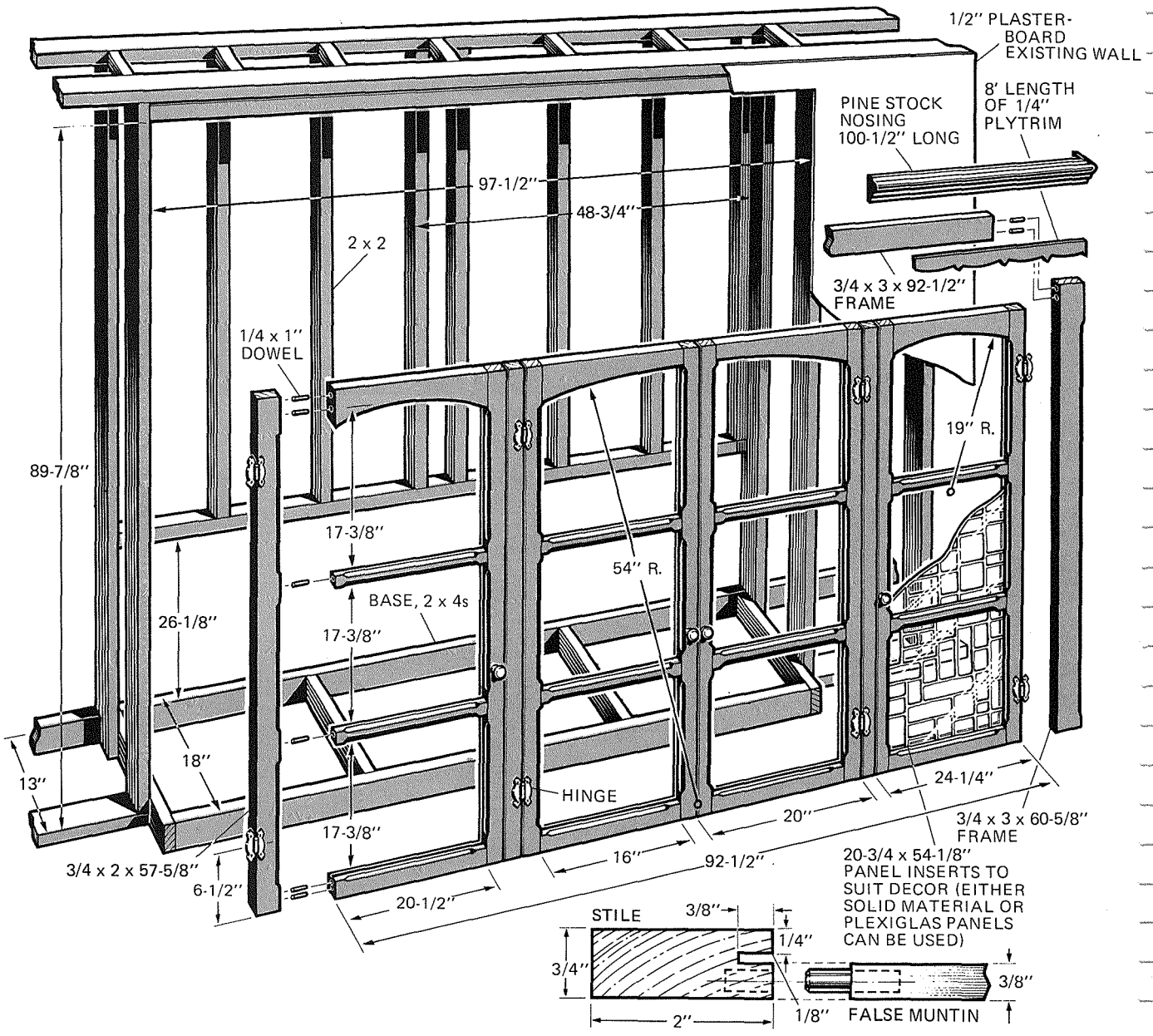
AFTER HANGING the doors, line up knob locations with a level and carefully drill holes for the screws.



FOR EASY ACCESS, all equipment is on sliding trays. Glazing bright metal parts made them "disappear."



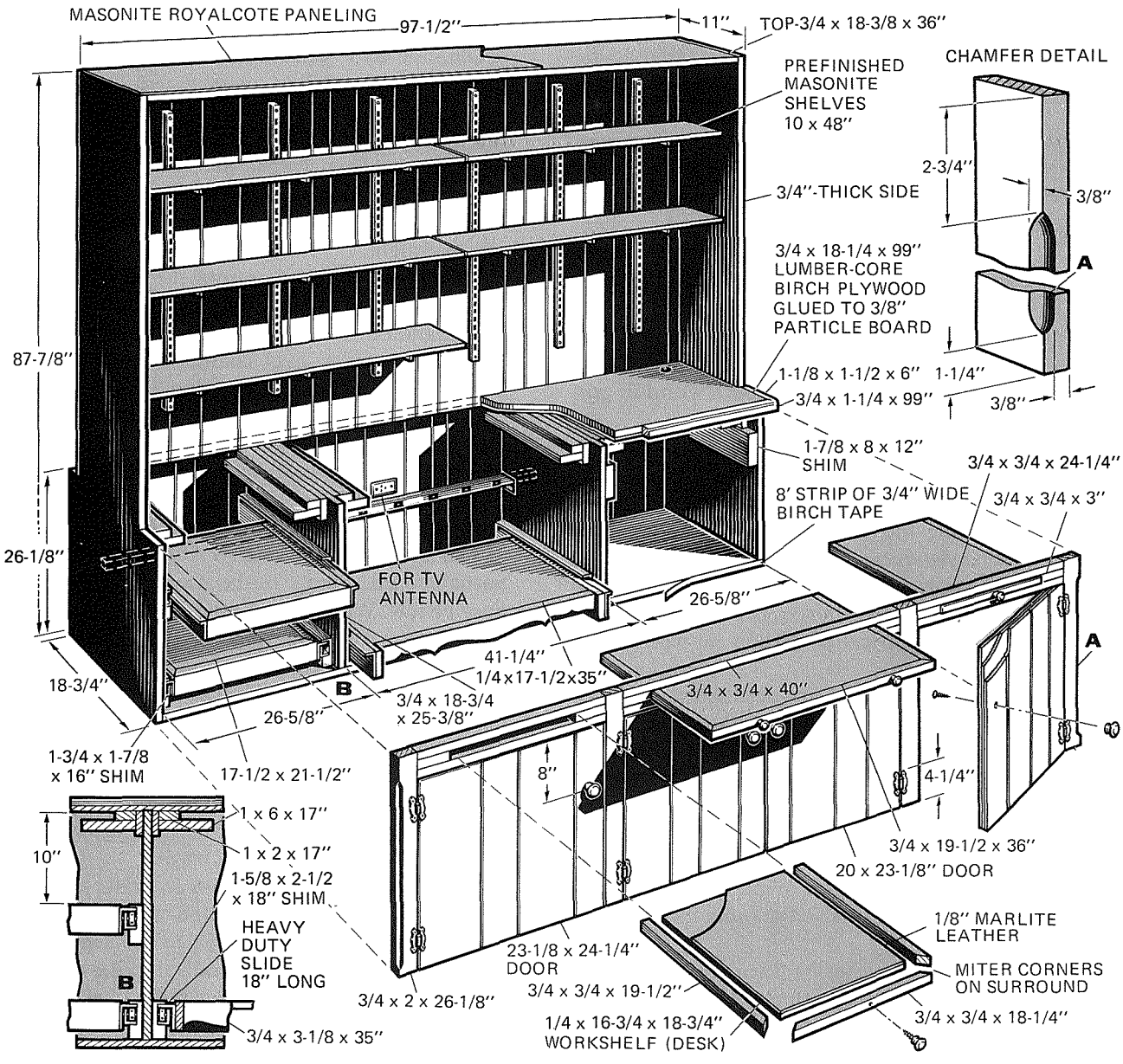
EQUIPMENT TRAYS and pullout writing surfaces were covered with Marlite's Leather for extra durability.



vision sets will be the student's homework aid. For example, by adding Motorola's EVR Teleplayer to your TV, it is just as easy to play an audio-visual program as it is a standard audio recording.

• *Getting started.* Standard construction techniques were used throughout. To speed up the job, I used Masonite's Cape Cod Maple paneling (¼-in. hardboard) on the walls and rock maple for the visible structural parts. Instead, you may prefer to use a different wood paneling and wed it to its real wood counterpart. Prefinished Masonite shelving and Marlite Leather board on the pullout writing surfaces add richness and durability, while cutting your time and costs further. The drawings illustrate the learning center exactly as I built it. Dimensions, of course, can be varied.

Start construction by removing the existing baseboard. Lay out the lines for the top plate on the ceiling. Then locate the ceiling joists, and fasten the top plate with 16d nails. If the plate doesn't cross the joists at right angles, use some panel adhesive and toggle bolts (spaced 12 in. apart) to fasten the plate. Drop a plumb line to locate the sole plate, then position and fasten it. After the top and bottom plates are placed, locate the wall studs and fit the 2x4 uprights,



header and other structural members.

Cover the 2x4s with plasterboard tape, Spackle and paint it. If you wish, panel the false wall to counter height and cap with chair-rail molding stained to match.

• *Case.* Install the 2x4 base and baseboard molding. Locate the studs and nail the 2x2 horizontal divider and uprights against the wall. Note that one 2x2 upright is nailed and glued with panel adhesive in the center to insure nailing support. Use a level to make sure all the 2x2s are plumb.

Saw the plywood end pieces to size. Nail and glue cleats and shims on each end. Again, verify the height of the equipment you will use and change location of the shims if required. To be sure the ends are plumb, test with a level. Fasten ends in place with panel adhesive and 8d finishing nails. Use adhesive to install the paneling in the top and back of the upper section, then screw the slotted shelf standards through the paneling and into the 2x2s.

• *Lower cabinets.* Provide for a TV antenna jack and electrical outlets in the rear of the lower cabinet. Then glue that paneling into place. Fasten the TV plate.

Install a Plugmold strip using the instructions packed with the hardware. Position the

6-ft. strip according to your expected need for outlets.

Cut and install the plywood base next. Apply birch tape to the front edge of the plywood base. In order for the doors to close properly, be sure the ends extend beyond the base a scant ⅛ in. Make the counter by cutting the plywood to size and gluing to the particleboard with white glue. When it's dry, cut off the waste particleboard. Glue and dowel the 1½ x 6 x 1⅛-in. end pieces. Fasten the ¾ x 1⅛-in. strip to the front edge with plastic resin glue and 6d finishing nails. Counter-sink all nails. Curve the end pieces and front edge with a plane and smooth with 120-grit sandpaper.

Make the partitions next from two remnants of ¾-in. plywood. Edge-glue two pieces and secure by gluing and nailing two cleats at the top. Also, nail and glue the shims for the metal sliding-drawer hardware and typewriter table. Mark and notch the rear edges of the partitions so they fit around the Plugmold strip. Cut these notches oversize so electrical plugs can be passed between cabinets.

Place the counter in its permanent position and level it. Square both partitions and mark their location on the underside of the counter and on the base. Bring the counter to your shop and invert it. Mark the location of the three pullouts. Nail and glue 1x2s that form the pullout pocket sides to the underside. Then nail and glue the six runners for the pullouts. Wipe off any excess glue inside the pockets so the pullouts will slide freely.

Install the typewriter hardware on the underside of the counter according to the directions provided. Amerock's hardware has stops at typewriter and kitchen-counter heights. The overhang of this counter prevents the hardware from swinging to full height, but it will serve as a typewriter stand at the first stop.

Bore three 1-in. holes along the rear edge of the counter to pass electrical wires between the upper and lower sections. Give the counter a final sanding, put in position, check for level and fasten with glue and 8d finishing nails. Apply glue to the top and bottom of the partitions, and nail through the counter into them. Toenail the top and bottom front edges, making certain the partitions are plumb and protrude ⅛ in. from the edge of the base.

Cut stopped chamfers in the two end uprights, and nail and glue into place. Next, cut the two middle uprights and nail and glue to the partitions. Cut the three pieces that form the front of each pullout pocket-frame and glue in place.

Glue the door paneling next. To do this, cut each piece of paneling oversize and lay it face down on a flat surface. Spread glue evenly over the surface and lay an oversize piece of particleboard on it. Then spread glue on the particleboard and lay a second piece of paneling on its face to make a sandwich. Weight it and allow to dry overnight.

Install the doors by fastening the hinges to the cabinet first, then prop a door in place and mark the location of the hinge holes. After the doors are hung, snap a level chalkline to mark the horizontal position of the door pulls. After checking the snapped chalkline with a level, install the pulls and magnetic catches.

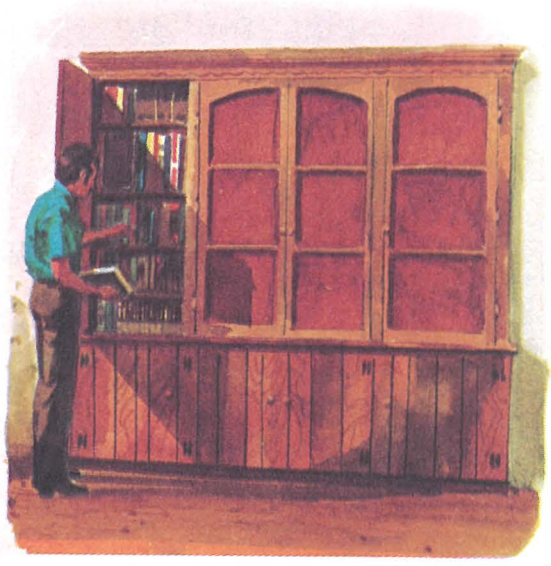
Screw the typewriter hardware to the shims. Make the pullout writing surfaces, typewriter shelf and equipment trays by glueing the entire 4x8 sheet of Marlite "leather" to a 4x8 sheet of particleboard, similar to the way you glued the door panels. When dry, cut the various panels to size. Cut the framing for the pullouts, equipment trays and typewriter shelf. (Standard typewriter table height is 26 in.) Verify the correct thickness of the frame for the typewriter stand so that it will be the desired height. Glue the maple frames to the Marlite panels. Fit the pullouts into their pockets and attach the brass pulls. After installing the typewriter shelf, fit the sliding drawer hardware on the equipment trays.

• *Upper cabinet.* Saw the two end rails for the upper cabinet to size, and cut the stop chamfers. Dowel and glue these uprights to the top stile. (Also dowel the two middle rails into the stile if you're putting in doors.) Then nail and glue the end rails to the plywood ends, and glue the stile to the top. Glue the nosing to a 2x2 to make the pediment molding. When dry, miter and glue into place. Glue the scallop trim into place next.

• *Upper doors.* To get the proper curve in the top stiles, and to avoid mistakes when chamfering, draw a full-size pattern of the doors. Cut the rails and stiles for the doors and dado for the inserts you plan to use. To make the muntins, cut the two stop-chamfers on the edge of a board that's at least 2 in. wide; then rip off the ⅜-in.-thick muntin with a planer blade. Dowel the rails, stiles and muntins and cut the insert panels.

Start by giving all maple parts a thorough sanding with 180-grit paper after filling nail holes. I brought scraps of the Royalcote paneling and white maple to my local paint dealer and asked him to prepare a stain to match the Masonite paneling. And I learned something. Maple

doesn't take stain—it requires glazing. He started with a pint of glazing liquid and added various colors to achieve a near-perfect match. The glaze is applied with a brush, then spread with a second, dry brush. Keep wiping this dry brush with a rag as you spread the glaze to simulate texture and grain. When the glaze has dried, you can apply burnt sienna in fine wavy lines with an artist's brush. Then blend this out by wiping *once* in a single direction with a rag. I covered this with two coats of O'Brien's Satin Finish Penchrome varnish. Finally, glue the upper doors together with plastic resin glue.



WALL CABINETS can be enclosed with doors (right) or left open (below) for display of modern equipment.

PANELING provides appropriate backdrop when given a wipe-off coat of thin oil paint.

A wall-hung study center

These off-the-floor desk and storage units save space in your kids' room. They're relatively inexpensive and easy to build with ordinary hand tools from your shop

AFTER HORIZONTAL boards are nailed to verticals, all permanent shelves are installed with screws.

SEE ALSO

Cabinet furniture . . . Children's furniture . . . Desks . . . Desks, children's . . . Modular furniture . . . Room dividers . . . Storage walls

■ IF YOU CAN SAW a board, you can build this wall-hung study center, for that's just about all you have to do to make it. You start out with plain flat boards and simply saw them to length, without even touching the width. The important thing is to saw the ends square.

In designing the project around standard-size boards which any lumberyard sells, David Blair, West Coast architect, not only has reached the ultimate in simplified construction, but has created a handsome, functional piece that any school boy (or girl) would be glad to have.

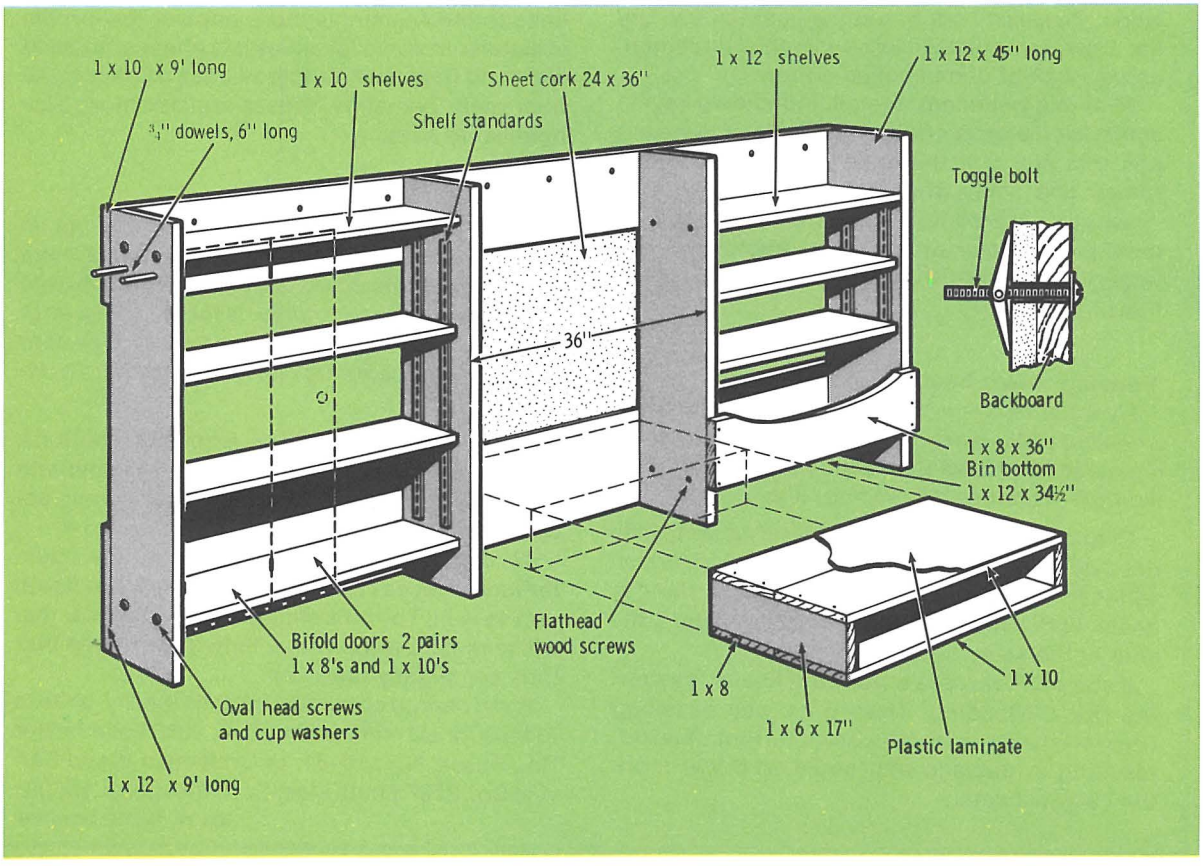
It provides an off-the-floor desk with shelf below, a cork pinup board for displaying star-studded papers, roomy shelves for reference books and a cupboard for storing all the wonderful treasures a boy collects. Pegs provide a place for a young cowboy to hang his six-shooter. There's even a bin to corral stray toys.

Remember that a 1 x 12 board, for example, is not a full 1 in. thick and 12 in. wide, but actually measures ¾ x 11½-in. This is true of all dimensioned lumber. Actual measurement is less than stock size.

Any solid lumber of the western pine species, such as ponderosa pine, larch or white fir, is appropriate. A natural finish (protected by a clear sealer) combined with painted cupboard doors, plus a colorful plastic desktop, will give it eye appeal.

Nails are used to fasten the 9-ft. 1 x 12s to the vertical members, and they are also used when nailing the desk compartment together. All the rest of the members are joined with 1½-in., No. 10, oval-head screws which are first seated in chrome cup washers and inserted in predrilled holes in the wood. The three adjustable cupboard shelves rest on regular shelf standards and supports. Six 2½-in. toggle bolts are used to hang the unit.

Depending on the grade selected (common grades of lumber cost considerably less than clear) the wood for the complete project will run from $20 to $40. Hardware will come to about $4.50, the cork, $3.25 and the plastic laminate, $2.75. To this you'll add the cost of glue, contact cement, paint and sealer. Total cost will vary and you may find that you can build it for under $40.



Desert-dry air in rooms

Why does air in my home dry rapidly when I start my furnace in the fall?—W.H., Wis.

Is your furnace humidifier working properly? It should be checked before the start of the heating season. If it's clogged or coated with lime and other deposits it should be put in working order. If it's of the type having a float-controlled valve a tablespoonful or two of white vinegar added to the water will help to break up hard deposits. Add it to the water in the pan.

Stated simply, when you heat the air in a closed structure it acts as a sponge, absorbing water (moisture) from everything with which it is in contact. The moisture is dissipated by the constant exchange of warm air from inside with the colder, drier air outside through walls, windows and doors.

Renewing gilt frame

I have an old oval picture frame with a liner in gold leaf. How can I clean and brighten the leaf to make it look somewhat like it did originally?—C.F., Md.

I'd clean the dust and debris from the liner first. Use a mild soap and warm water, applying the solution with a swab made by twisting a ball of cotton onto a toothpick or other small sliver of wood. Be careful not to wet the liner unduly. Dry the liner immediately following this treatment, using a ball of undampened cotton.

With this treatment, the gilding should regain at least some of its original brilliance. If there are pits that still dull the liner you can go a step farther and apply what is commonly known as "wax gilt," a product that's available from your local paint dealer or art store. Apply it with a fingertip and burnish according to the instructions.

'Popping' water heater is pooped

My water heater is about 10 years old and now, when hot water is drawn, there's a hissing, crackling noise for a couple of minutes. What could be wrong?—Tom Kusker, Racine, Wis.

Chances are that your 10-year-old water heater has had it, especially if you don't have a water softener. You would be wise to replace the old heater with a new one and to install a water softener at the same time.

If you don't replace a worn-out heater, you run the risk of flooding. There's no way of telling when the heater may let loose a torrent of water, resulting in damage that could cost you more than a new heater.

Puffing fireplace

I have a natural fireplace in a basement recreation room. When my gas furnace kicks on, the fireplace smokes—that is, a puff of smoke enters the room each time the gas burner starts its cycle. The fireplace upstairs is unaffected. What's the cause of this? And the remedy?—Lester Towns, Troy, N.Y.

Your basement must be nearly air-tight. When the burner kicks on, warm air rises in the furnace flue by convection. Air pressure in the basement is equalized by air drawn down the fireplace flue, forcing smoke and gases from the natural fire into the room.

Opening a basement window slightly or leaving the door to the basement stair open should cure or at least minimize the problem.

Two stories or one?

I live in an older home and plan to build a new one on property I own in a better section of town. I'm inclined toward a two-story house but am still undecided; the split-level type is not very much to my liking. What is your opinion?—J. Horowitz, Pittsburgh.

Your local architect and builder are in a better position to advise you. If present-day construction costs are not a limiting factor, I would prefer the two-story house with traditional architectural lines to the seemingly more popular low-profile structure. In some localities it is cheaper to build a second floor than to spread out to obtain equal floor area. Two-story houses are also more economical to heat.

Chair restoration

I have an old chair, not a genuine antique, in which the screws holding some parts have loosened and the heads are exposed, making the whole piece quite unsightly. Is there some way of concealing the heads of new screws I will have to use as replacements?—R.W. Hadley, Portsmouth, N.H.

Use what are known as screwhole buttons. These are made of hardwood and they come with flat and half-round heads. They make a neat, acceptable finish.

To apply these hardwood buttons, you counterbore to recess the head of the screw to a depth of ⅛ to ¼ in. The hole should have a diameter that will take the button with a light drive fit (the buttons are slightly tapered).

If you cannot obtain the buttons locally, write to Albert Constantine & Sons Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461, or Craftsman Wood Service Co., 2727 South Mary St., Chicago, Ill. 60608.

by W. Clyde Lammey

PLACED IN YOUR BACK YARD, an armillary sphere is sure to stimulate conversation. And, if you position it carefully, you'll be able to tell the time of day without budging from the patio. The skeleton-like sphere is an ancient astrological instrument consisting of rings that represent the important circles on the celestial sphere. This simple version uses sheet-metal rings and lamp parts.

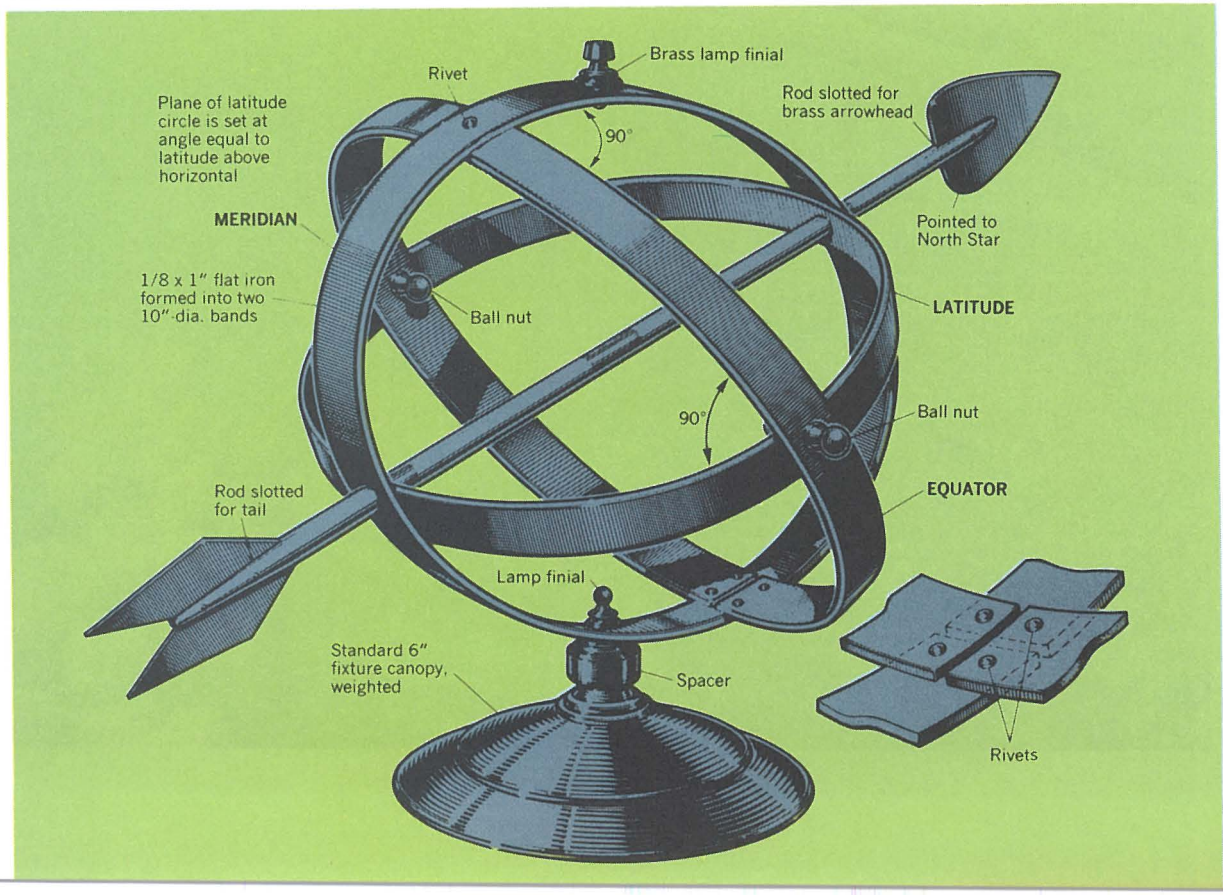
Roll the rings into 10-in.-dia. circles and assemble them at a 90° angle to each other. The arrow shaft, which represents the polar axis of the sphere, passes through the intersections of the meridian and latitude circles. The hole for fastening the sphere to the base is drilled after the sphere is assembled. To locate the hole, block the arrow shaft at an angle equal to your geographic latitude and drop a perpendicular from the center of the sphere.

If carefully constructed and properly calibrated, the sphere can serve as a sundial: The shadow cast by the arrow shaft on the equator circle indicates the hour.

Make a decorative yard ornament

SEE ALSO
Gardening . . . Landscaping . . . Lawns . . . Patios . . . Post lamps . . . Sheet metal

By JOHN DOUGHERTY



10 steps to a sparkling pool

To get the maximum enjoyment from your pool, you'll want to start a regular program of maintenance. Here are 10 things to consider when setting up your program

■ AN EFFICIENT pool-maintenance routine is required if family and friends are to enjoy clean, healthy, sparkling water throughout the pool season. Here are 10 things to do to keep your pool—be it in-ground or above-ground—clean.

1. Determine your pool's capacity. Though pool water may appear clean and clear, if neglected, it can quickly become a breeding place for microscopic bacteria and tiny plant life called algae. Bacteria, viruses and algae cannot multiply in pool water properly treated with an inorganic chlorine sanitizer. Before you can start the chemical treatment of your pool water, you must determine the pool's capacity in gallons to give correct dosages.

If pool is rectangular or square, multiply length x width x average depth (feet) x 7.5 = total gallons (7.5 represents the number of gallons in a cubic foot of water).

If circular, multiply diameter x diameter x average depth x 5.9 = total gallons.

If oval-shape, multiply long diameter x short diameter x average depth x 5.9 = total gallons.

2. Maintain the proper pH level. If your pool contains more than 1000 gallons of water, it's essential that you test the pH level of your water at least once a week. Chlorine effectiveness is closely related to the pH level of the water. The pH scale (it runs from zero to 14) is a measure of the acidity-alkalinity level of water.

Water having a pH level between zero and seven is acidic; water having a pH level between seven and 14 is alkaline. The ideal pH range for pool water is between 7.2 and 7.6—a point where the water is slightly alkaline.

To get the pH level between 7.2 and 7.6 you should buy a reliable pool-test kit available at any pool-supply store. The test kit uses a phenol red indicator solution that changes color at different pH levels. It also should have an OTD (orthotoluidine solution) test involving color changes for chlorine residual.

3. Maintain an effective chlorine level. To satisfy the initial chlorine demand and establish a free available chlorine residual, you must treat your pool water with daily dosages of the correct amounts of chlorine sanitizer. At times, additional dosages will be required to overcome special problems such as heavy use of the pool, long periods of rain, or winds bringing in debris and pollen.

Use your pool test kit to check the level of available chlorine in the water. This should be done every day. This chlorine residual should be kept at between 0.6 and 1.0 parts per million (ppm) for unstabilized pools, and between 1.0 and 1.5 ppm for stabilized pools (these terms are explained in the following step).

4. Stabilized water could be for you. Since the sun's ultraviolet energy tends to dissipate available chlorine in pool water, pool owners who live in areas experiencing long periods of sunshine and heat may find that the chlorine residual in their pool water is being consumed quickly.

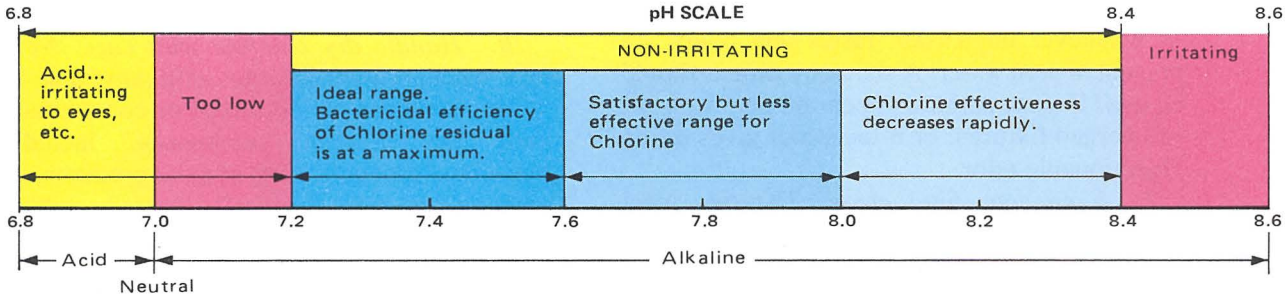
This problem can be overcome by stabilizing pool water with a chemical called cyanuric acid. Cyanuric acid protects the chlorine residual in pool water, yet it is nontoxic, does not affect the disinfection process and does not decompose.

5. Watch out for chlorine lock. If you decide to stabilize your pool water, even though you may have followed the manufacturer's directions to the letter, an excessive amount of cyanuric acid in the water can reduce the effectiveness of your chlorine sanitizer.

To remedy this condition, use a test kit that

SEE ALSO
Cabanas . . . Carpeting, outdoor . . . Poolhouses . . . Yard lighting

Target pH levels for pool water



THE SECRET to a beautiful pool, such as the one shown here, is regular maintenance.

checks levels of cyanuric acid. If the level is too high, remove enough water from the pool so that the 25 to 50 ppm stabilizer level is achieved when the pool is refilled.

6. *Quick cures for warm-weather problems.* If your chlorine residual drops below recommended levels for any length of time, bacteria, unsightly algae patches and bad tastes and odors are certain to appear. Two powerful weapons that can be used to combat these problems are superchlorination and shock treatment.

Superchlorination is an extra heavy dose of chlorine—roughly 1 oz. of dry chlorine (65 or 70-percent available chlorine) added to 1000 gallons of water. Shock treatment is a dosage that is twice as powerful—1 oz. of dry chlorine (65 or 70-percent available chlorine) added to 500 gallons of water.

You should superchlorinate when a pool is opened for the season, when a pool is refilled, after a long period of sunny and hot weather, after heavy use, after severe rain or windstorms, or whenever unpleasant tastes and odors are present in pool water. A shock treatment should be used if algae patches appear on pool walls or submerged fixtures, or if the water gives off an objectionable odor.

7. *Keep your filter clean.* The two most commonly used filters are sand filters and diatomaceous-earth filters. Pool water is recirculated through the filter under pressure created by a pump. Increased pressure is usually an indication of ineffective filtration.

A pressure buildup across the filter occurs when the filter is clogged with sediment and dirt from the pool. Best cure is to backwash it (reverse the flow of water) according to the manufacturer's instructions.

8. *Use vacuuming equipment.* Swimming-pool vacuum cleaners operate on the same principle as ordinary home vacuum cleaners except that water is drawn through the machine instead of air. Sediment and dirt drawn from the pool floor and sides are carried through the cleaner's piping for removal through the filter.

9. *Don't forget the skimmer.* Practically all pools have an automatic surface skimmer built directly into the pool or attached to the filtering system to remove leaves, bugs and other floating objects from the water. During filtration, surface water is drawn through the skimmer and into the filter, carrying off dust, oil film and other inert matter before it can settle to the pool floor.

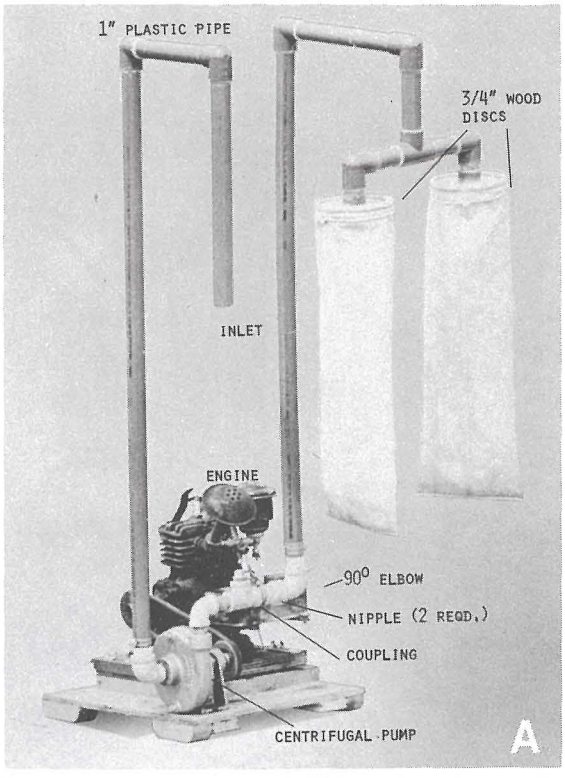
10. *Handle dry chlorine with care. Never* mix calcium hypochlorite with anything but water. It should not be mixed or contaminated with any foreign substances, including household products, soap or paint products, solvents, acids, pool chemicals, vinegar, garbage, beverages, oils, pine oil or dirty rags. Always keep burning material such as a lighted cigaret away from any container of dry chlorine.

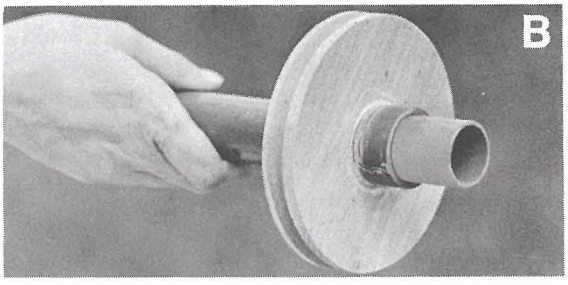
A swimming pool filter you can make

By JAMES M. MILLER

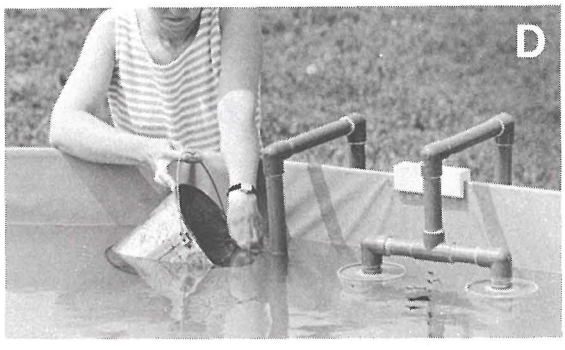
■ I RIGGED A FILTER for my 15-ft. above-ground pool from an old lawn-mower engine, a 30-gpm centrifugal pump from Sears, some 1-in. plastic pipe and two canvas bags, as shown in photo A.

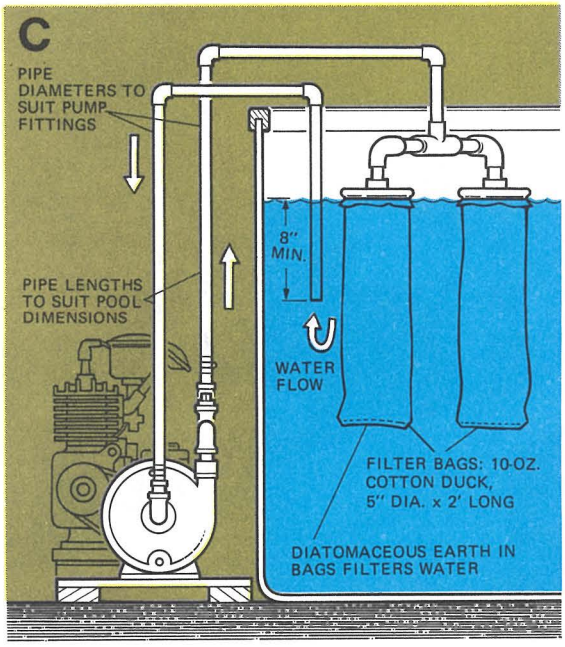
To use the filter, you first prime the pump by running a garden hose in the intake pipe. Next you place diatomaceous earth in a bucket and mix with water until you have a thick slurry. (Use ½ lb. of earth for each filter bag.) Submerge the bucket in the pool under the intake pipe (photo D), and with the pump running, suck the slurry into the canvas bags. The earth, coating sides of the bags, does the filtering. It takes about six hours a day to filter my pool.





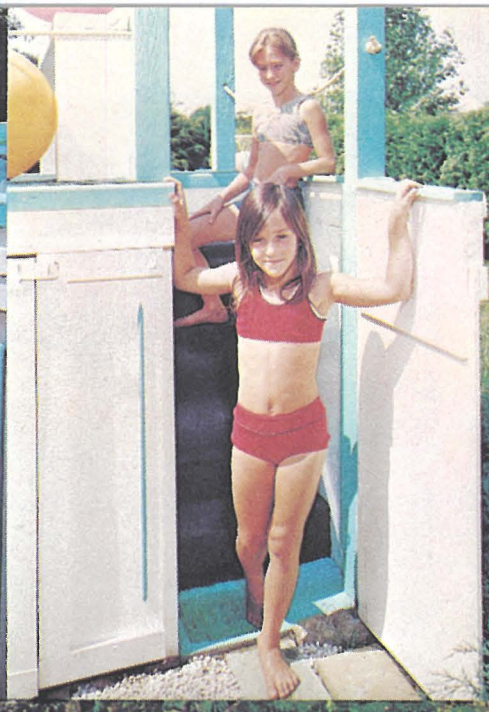
THE WOOD DISCS that hold the filter bags (photo B), are cut from ¾-in. solid wood, grooved around the edge for drawstrings, waterproofed with three coats of marine paint and cemented to the plastic pipe with epoxy. Use two bags for 15-ft. pool, three for 18-ft. Intake pipe should extend at least 8 in. in water to prevent pump cavitation (diagram C) and permit swimming while filter runs. Each supply pipe should be about 20 in. long. If near an outlet, electric motor can be used to drive the pump; I used a gas engine because my pool was too far from house.




C
PIPE DIAMETERS TO SUIT PUMP FITTINGS
PIPE LENGTHS TO SUIT POOL DIMENSIONS
8" MIN.
WATER FLOW
FILTER BAGS: 10-OZ. COTTON DUCK, 5" DIA. x 2' LONG
DIATOMACEOUS EARTH IN BAGS FILTERS WATER

SEE ALSO

Cabanas . . . Carpeting, outdoor . . . Poolhouses . . . Yard lighting



A diving deck gives added storage

This structure solves two problems at once. It provides a diving deck for your above-ground pool and a place to store outdoor equipment and the pool filter

By HARRY WICKS

ABOVE-GROUND POOLS have become very popular. A common problem, however, is providing a diving arrangement as a "launching pad" for the kids. In addition to being unsafe, a diving board is just too hard to rig in an elevated position.

We were determined to solve this problem, and the diving deck shown here is the result. Our main goal was to provide a safe diving platform. But, in addition, since footage would be taken from the yard, we wanted the space beneath the deck to serve as seasonal storage as well as to house the pool filter system. It was also decided to place the stairs behind the door to protect young ones. Extras that "make" the structure include a foot bath, indoor/outdoor carpeting and nautical rope for the railing.

construction is easy

Design is basic; there are no fancy, frilly construction techniques. Tried construction methods were used to insure maximum sturdiness, yet details were kept simple to keep costs down to a minimum. For example, careful layout permitted cutting the deck from just two 4x8-ft. sheets of exterior plywood with practically no waste.

Overall dimensions of the deck can be varied to suit the size of your family. The version shown provides ample room for sunbathing as well as diving. One critical measurement to keep in mind—when laying out your structure—is the portion of the deck that overhangs the pool. This can be altered to suit without any problems.

The four-by-four posts are anchored to footings which should be below your area frostline. Once the four-bys are in place, and the concrete has set, the post-holes can be backfilled and cutoff marks at the top located. To do this, determine desired height on one corner post and mark off the other posts using a mason's line and line-level.

Top and bottom rails are simply spiked to the posts and framing is completed with joists and bridging installed. The rails and posts are fitted with cleats positioned to give a setback (architectural shadowline) when the exterior plywood panels are in place. (In place of cleats, the 2x4 rails can be edge-rabbeted on a table saw.)

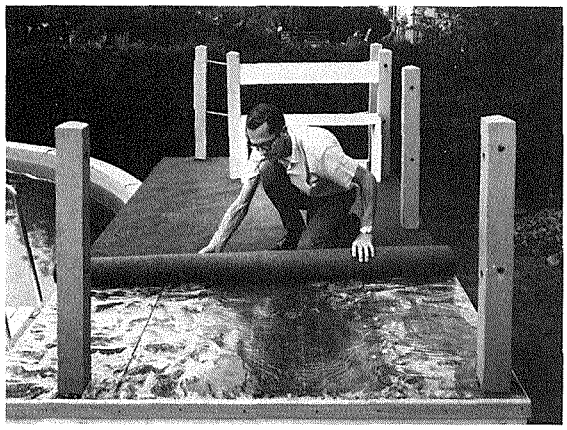
Doors to the storage area and stairs are simply plywood panels framed with rails and stiles fastened to the structure with strap hinges. Catches to hold them closed and vertical half-round moldings complete their construction.

the stairs

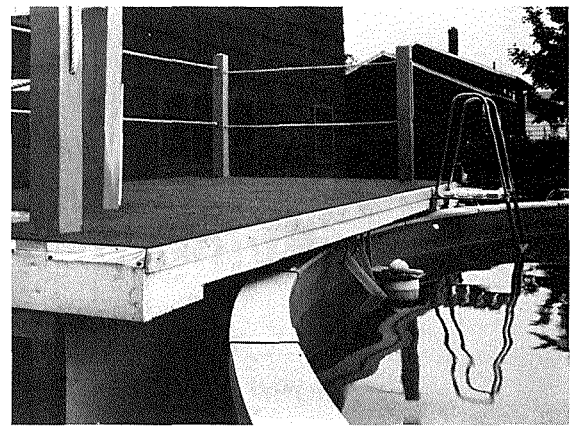
A limited run made a steep riser-to-tread ratio a must. But, unlike conventional stairs, it is not a drawback. Actually, their "marine-ladder" steepness adds to the nautical design.

AN ABOVE-GROUND POOL mandates a structure alongside for diving fun. This one has steps inside (upper right) that are inaccessible when the door is locked. Space behind the doors (upper left) is ample for year-round storage of bike and yard equipment plus the pool filter.

SEE ALSO
Benches, deck . . . Cabanas . . . Carpeting, outdoor . . . Decks . . . Poolhouses . . . Yard lighting



INDOOR-OUTDOOR carpeting insures skidproof footing. It is laid over 15-lb. felt and 6-mil polyethylene.



THE PLATFORM overhangs the pool slightly. Measurements might vary from the drawing to suit your pool.

The deck can be finished using an exterior latex paint with some fine masonry sand mixed in for skidproofing. (Or, you can purchase a ready-mix sand paint.) But our suggestion is to cover the plywood with 15-lb. felt, followed by 6-mil polyethylene and Ozite outdoor carpeting. (The felt waterproofs the storage area while the polyethylene prevents any possible stains from the felt rising to the carpet.) Either way the finished surface is an effective safeguard against accidental skids and falls. The latter method is just more comfortable underfoot.

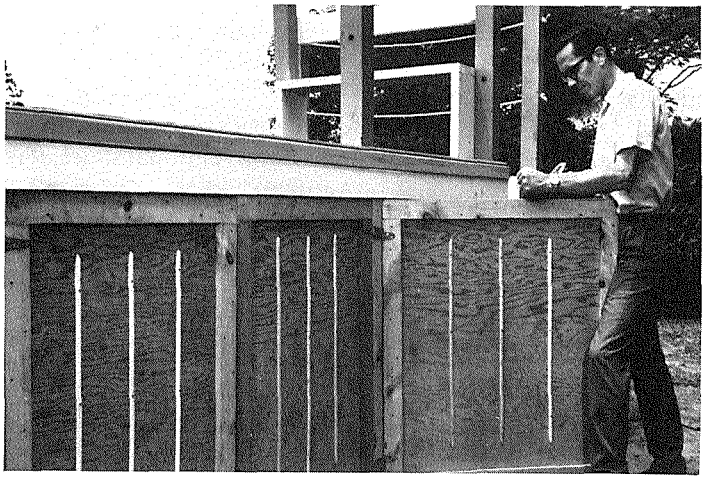
bath at bottom is optional (it's an inexpensive plastic baby bathtub from Sears, Roebuck), but it does decrease the mud tracked up to the deck carpet by overzealous youngsters.

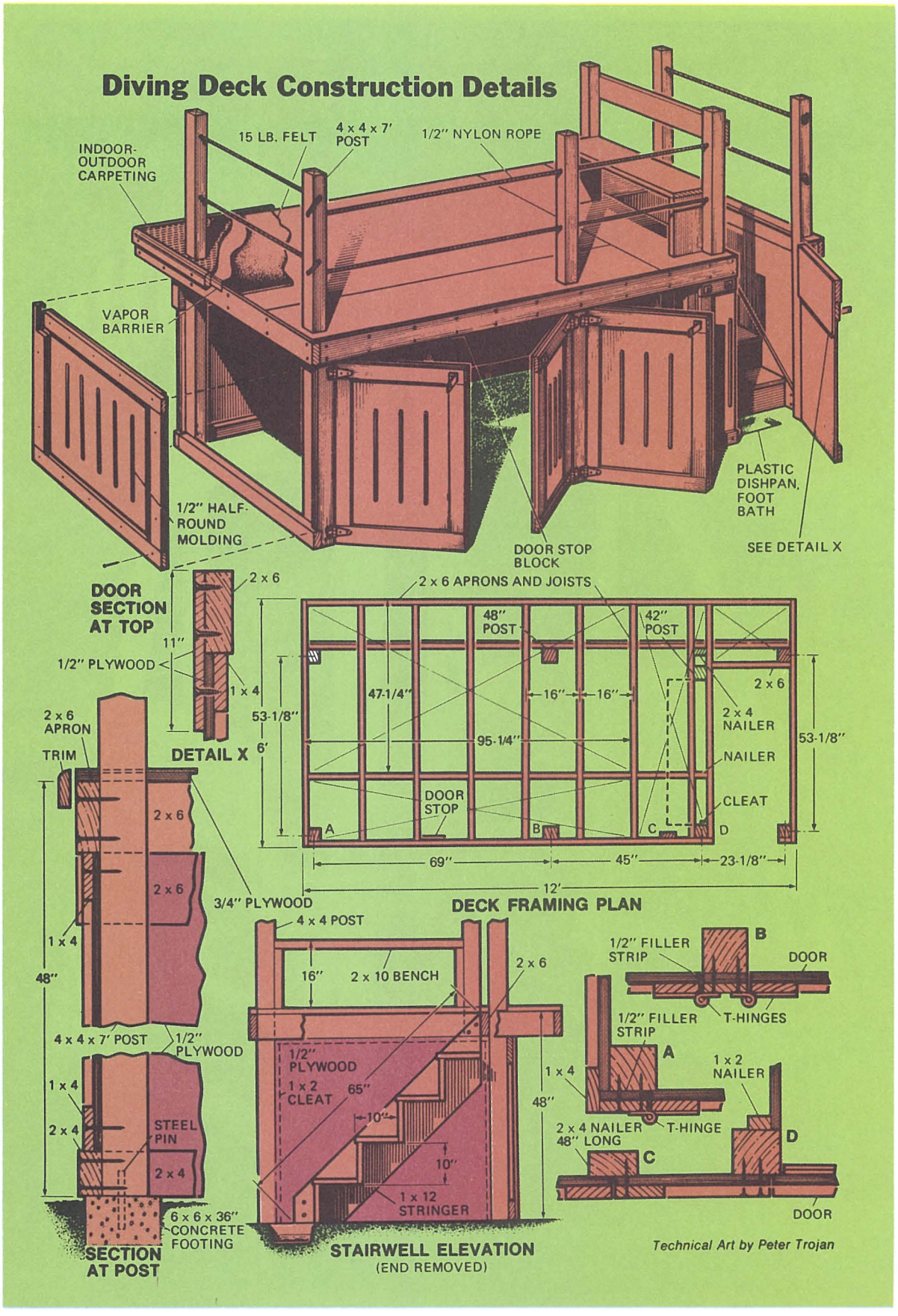
Since a slab wasn't used here, you'll notice in the photos that the structure walls leave space at the bottom to permit rainwater runoff. If you prefer slab construction, you are well advised to install a block wall or form the slab to create a curb. A standard soleplate can then be installed, with posts toenailed to the plates, and conventional wall framing used. But remember that a slab would require the addition of a pitched apron in front of the doors to provide positive water runoff. The apron will also make it easier to roll bikes and other wheeled vehicles in and out of the storage area.

To finish, the entire structure was primed and painted (inside and out) with a high-quality, latex house paint. (For additional safety, the stair treads could also be carpeted or coated with a sandmix paint to make them skidproof.)

The prototype project shown took the owner four weekends to complete. He started it late in April, and by the time the thermometer climbed to swimming temperatures he was happily spending his vacation atop his "Slip-Proof Diving Deck" in his own back yard.

THE STORAGE DOORS are built with one-by stock and ¼-in. plywood. Half-round moldings are added to give a decorative touch. As shown at right, the prebuilt stairs are lowered into position after frame is complete.




Diving Deck Construction Details
INDOOR-OUTDOOR CARPETING
15 LB. FELT
4 x 4 x 7' POST
1/2" NYLON ROPE
VAPOR BARRIER
1/2" HALF-ROUND MOLDING
DOOR STOP BLOCK
PLASTIC DISHPAN, FOOT BATH
SEE DETAIL X
DOOR SECTION AT TOP
2 x 6
11"
1/2" PLYWOOD
1 x 4
DETAIL X
2 x 6 APRONS AND JOISTS
48" POST
42" POST
47-1/4"
16"
16"
2 x 6
2 x 4 NAILER
53-1/8"
6'
95-1/4"
NAILER
CLEAT
DOOR STOP
A
B
C
D
69"
45"
23-1/8"
12'
DECK FRAMING PLAN
2 x 6 APRON
TRIM
2 x 6
2 x 6
3/4" PLYWOOD
1 x 4
48"
4 x 4 x 7' POST
1/2" PLYWOOD
1 x 4
2 x 4
STEEL PIN
2 x 4
6 x 6 x 36" CONCRETE FOOTING
SECTION AT POST
4 x 4 POST
16"
2 x 10 BENCH
2 x 6
1/2" PLYWOOD
1 x 2 CLEAT
65"
10"
10"
1 x 12 STRINGER
STAIRWELL ELEVATION
(END REMOVED)
1/2" FILLER STRIP
B
DOOR
1/2" FILLER STRIP
T-HINGES
A
1 x 4
1 x 2 NAILER
48"
2 x 4 NAILER 48" LONG
T-HINGE
D
C
DOOR
Technical Art by Peter Trojan

Build this old-time yard swing

By WAYNE C. LECKEY

This two-seater is not only a reminder of yesterday, but a challenge for any craftsman

■ THE TWO-SEAT LAWN SWING of yesteryear is making a comeback. Once a familiar sight in everyone's yard, this old-time favorite is finding new life even in this modern age of air-conditioning. The spot where you'd once go to seek cool breezes on a hot summer's night, such a swing has become a welcome place to get away from teen-age din, to relax and unwind—or occasionally just to sit and think.

My folks had one when I was a boy and I can remember what fun it was to stand up and pump, making believe the swing was a train. Later I found it to be one of the more favored spots to watch the moon with my best girl.

You can bring back a bit of the good old days by copying this old-time swing, setting it up in your yard and becoming a real "swinger" once again to the envy of your neighbors.

The whole thing is made from standard lumberyard materials, which means that all the members are already the right thickness and width when you get them. For the most part you simply cut the pieces to length and bolt or screw them together. The exceptions are the four curved seat rails. Many of the members are alike, with two or more of each required.

Start with the swing-supporting framework detailed in the drawings. Here 8-ft. 1x4s are used for the legs and braced with 1x3s and 2x2s. Notice that the 1x3 side braces lap the legs, one inside and the other outside, and are filled where they cross each other with a ¾-in.-thick spacer block. Notice, too, that the legs spread out at the bottom in both directions for better rigidity and overall strength.

The conduit rods from which the swing seats hang are tightened securely between the legs by nuts and washers as shown in detail A. Standard ⅜-in. Redibolt rod is used inside the conduit. Carriage bolts are used to secure the braces.

THE CROSS BRACES for the supporting framework are bolted securely to the four legs.

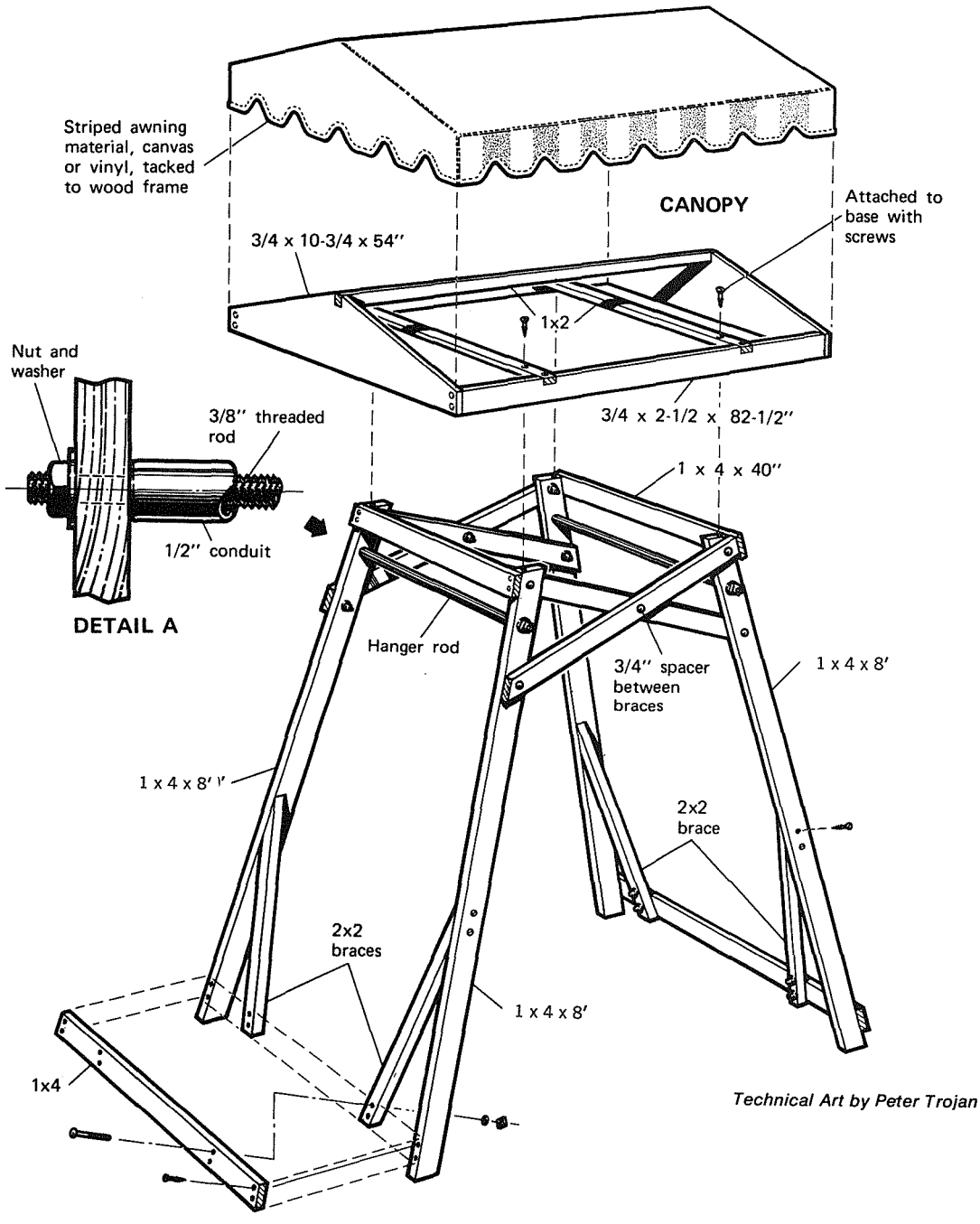
EACH SWING ASSEMBLY is hung from conduit hanger rods which fit between supporting legs.

SEE ALSO

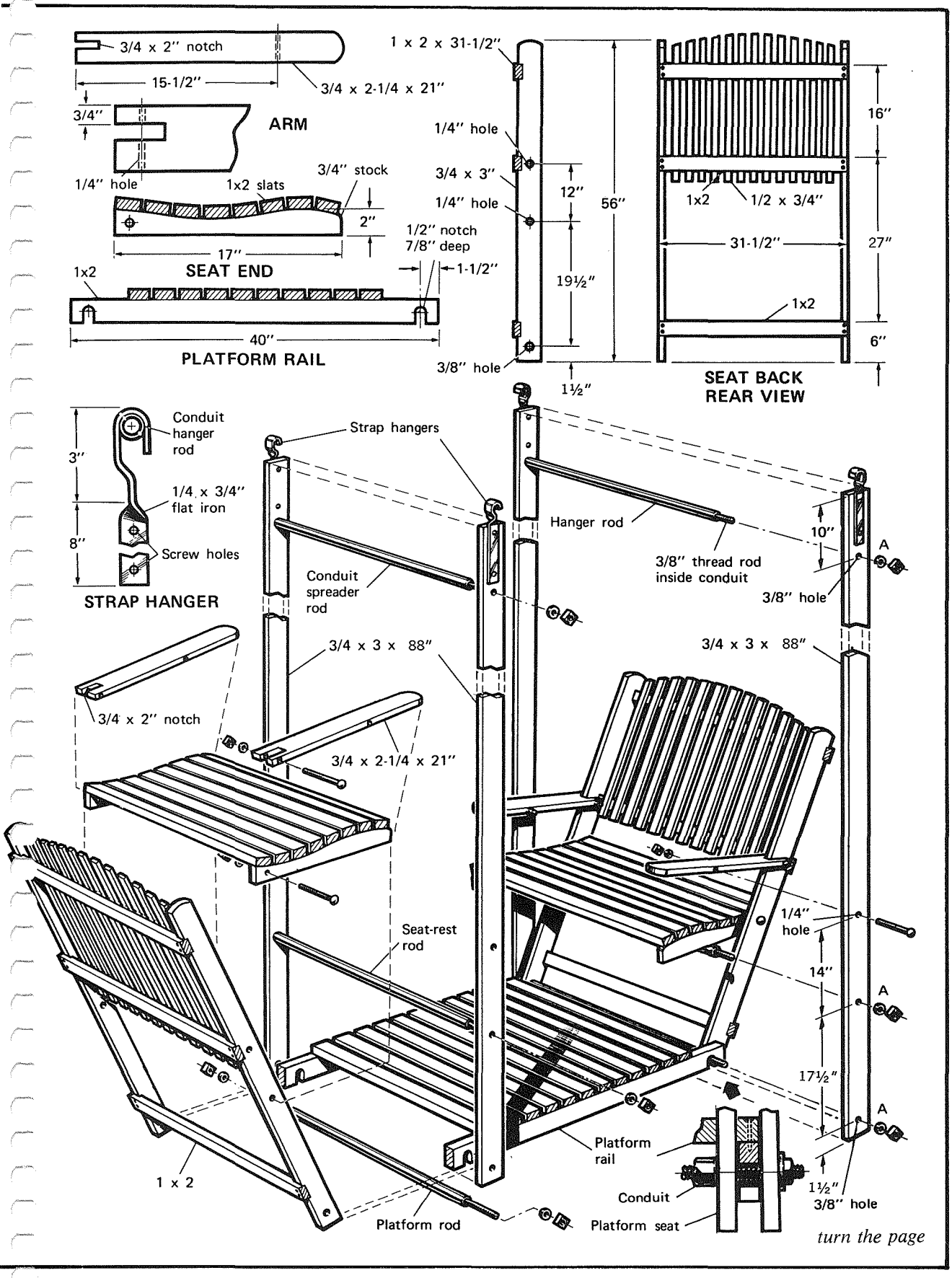
Landscaping . . . Lawns . . . Paths, garden . . . Patios . . . Playgrounds

yard swing, continued

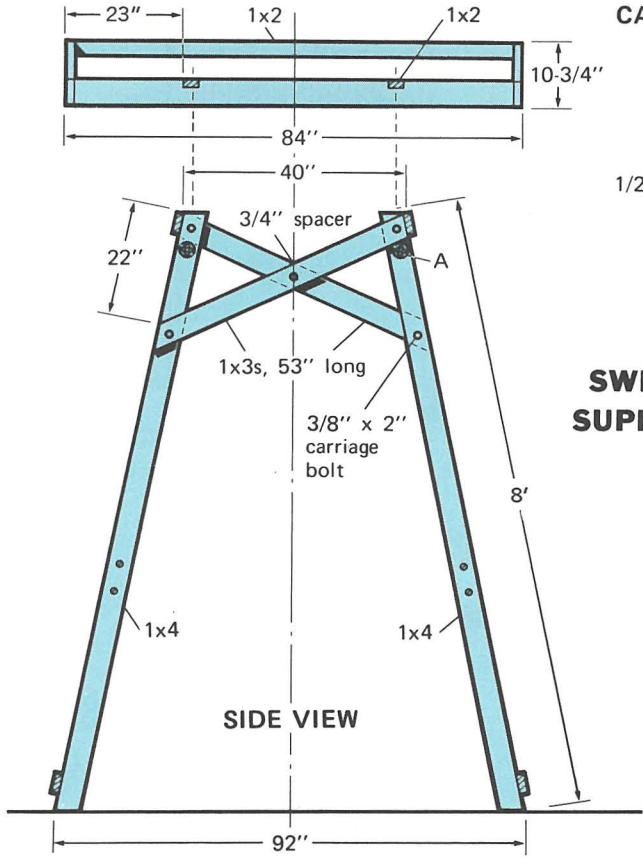
LAWN SWING EXPLODED VIEW

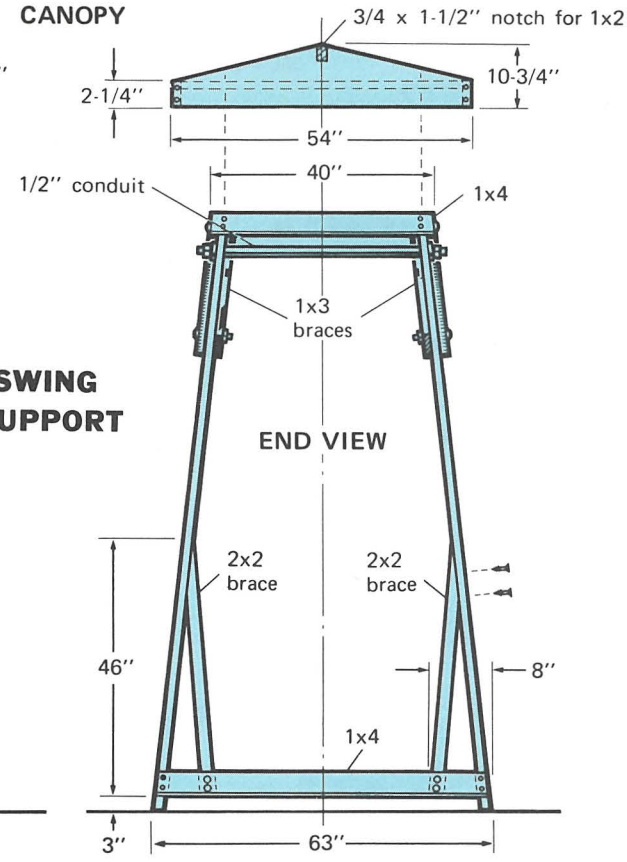


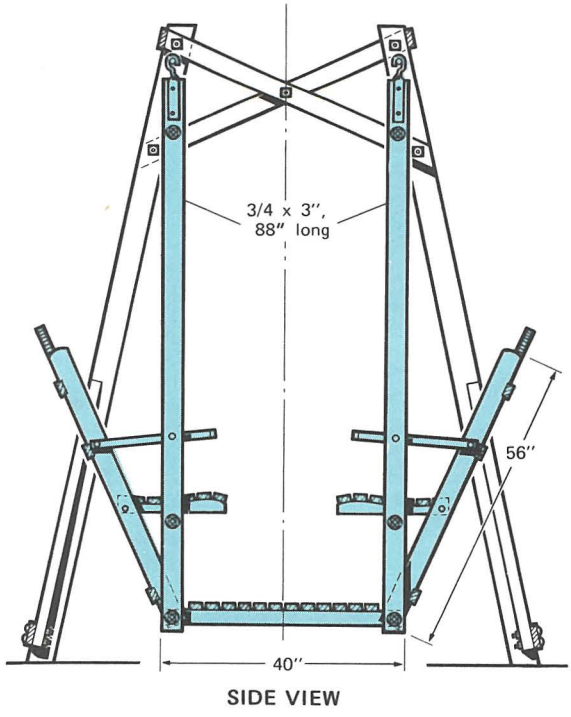
Technical Art by Peter Trojan



turn the page





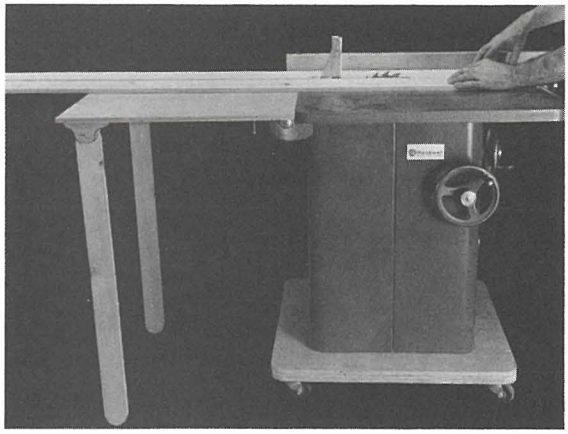


SIDE VIEW

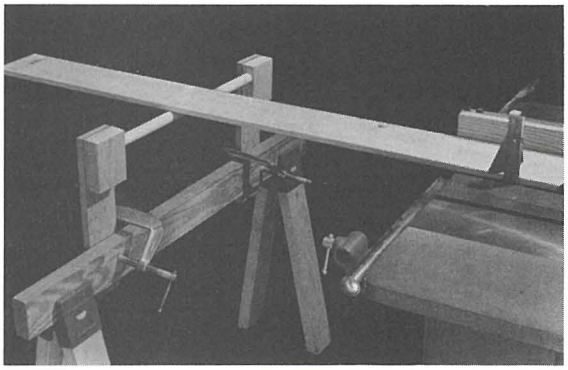
The swings are made alike, so you can save time by cutting duplicate parts. Start with the backs, then go on to the seats. You'll notice that three conduit rods are used for each swing-seat assembly which serve primarily as spreaders. The separate platform assembly hooks over the bottom one and the seat rests on the middle one. The notched ends of the platform actually insert between the uprights and the seatback members. Each swing is suspended by two straps that are bent from flat iron. A little grease on the conduit rods will keep the straps from squeaking.

The canopy is optional, although it does provide shade and adds a colorful touch. You make the supporting wood framework as shown and then tailor a canvas cover to fit it. Four screws down through the cross members of the wood frame are used to anchor the canopy to the swing.

Give your swing a couple of coats of good-quality exterior paint to help it stand up against the weather. You can paint the platform to match the strips in the canopy if you wish. Once the paint is dry, you are ready to relive the "good old days."



IF YOUR SAW has a rear rip-fence guide bar which is below table level, as on this Rockwell, attach a pair of pivoting legs to the rear edge of a plywood top and drive a row of 6d nails along the other to serve as hoods for attaching the unit.



THIS ROLLER support can be made of scrap, but does require a sawhorse and C-clamps. A 1-in.-dia. dowel is supported by blocks glued to 1x4 posts which are clamped to the horse so they're level crosswise and even with the saw table. Dowel is sanded down at ends.

Two extensions for a table saw

By ROSARIO CAPOTOSTO

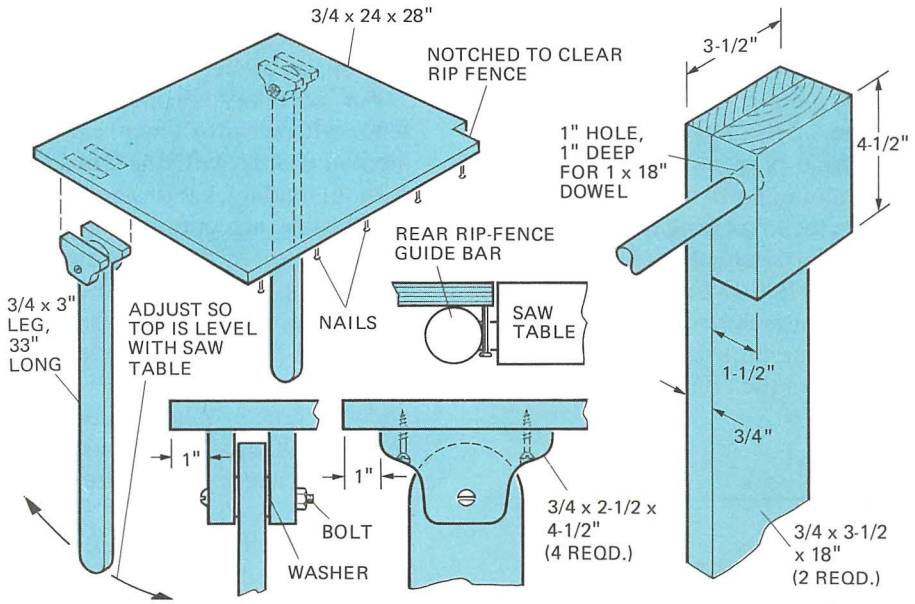
■ STRUGGLING TO HOLD a long board single-handed when you rip it on a table saw is not the best practice for either safety or ease of handling. Either of these "helping hands" will prove a valuable aid.

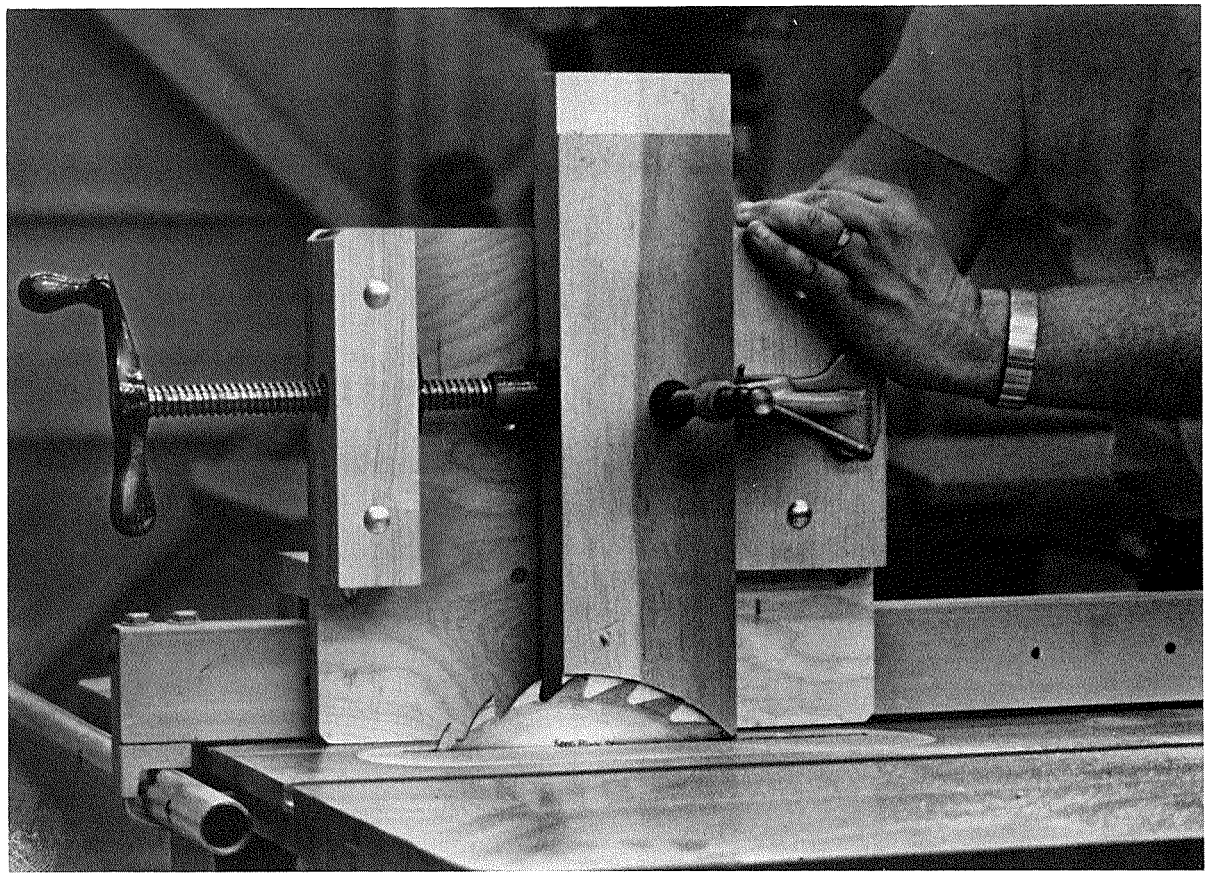
One is a roller affair attached to a sawhorse with C-clamps and the other is a two-legged plywood table that hooks over the saw's rear rip-fence guide bar. The friction-fit legs swing to bring the top even with the saw table, and to adjust to an uneven floor. Pick a straight dowel for the roller support, and sand and wax the ends so it turns freely as it supports the work.

Both take little space to store.

SEE ALSO

Bench saws . . . Motors, shop . . .
Power-tool stands . . . Workbenches . . . Workshops





Build a tenoning attachment for your table saw

By ROBERT K. WALLACE

■ THIS TENONING attachment will quickly prove itself to be an extremely useful addition to your table saw. With the exception of the handle, all of the parts can be quickly cut on the table saw.

The main frame of the attachment is of ¾-in., seven-ply birch plywood. For desirable strength, the remaining parts are of maple.

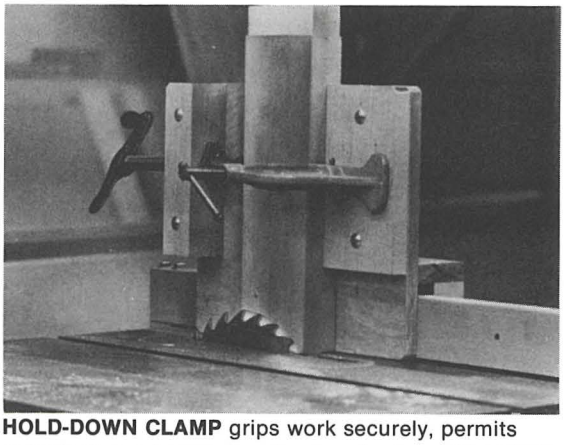
Begin by cutting the main frame to the dimensions shown. It's important that this board be perfectly square (and flat) since it is actually the "backbone" of the attachment. Next, cut the front and rear clamp mounts to size and drill the required holes. Square the rear clamp to the top edge of the main frame and mount it with two ¼-in. carriage bolts. Align the front clamp with the front edge—and top—of the frame and also bolt this in place.

For accuracy, proper alignment of the rip fence with the attachment is a must. The attachment must mate with the fence to allow a slide-fit without binding, yet it should not be so loose that it will cause inaccurate cutting. After cutting the guide boards to suit your rip fence, mount the handle support board with 1½-in. No. 8 f.h. wood screws to the main frame. Clamp the outside guide-board to the rip fence with two layers of newspaper between the outside guide-board and the fence. When mounting is completed, remove clamps and newspaper. (The paper strips are needed to insure clearance for easy sliding.)

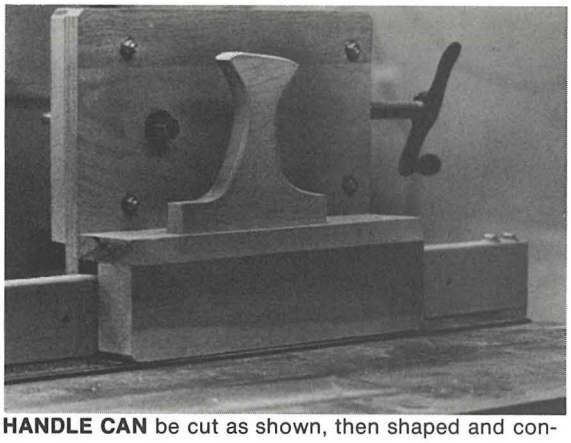
The front clamp is a 9-in.-long $^{11}/_{16}$-in.-screw assembly used in veneer presses. The rear clamp is a 3-in. hold-down clamp (Jorgensen No. 1623;

SEE ALSO

Bench saws . . . Joinery . . . Motors, shop . . . Power-tool stands . . . Workbenches . . . Workshops



HOLD-DOWN CLAMP grips work securely, permits operator to work while keeping hands clear of the blade.



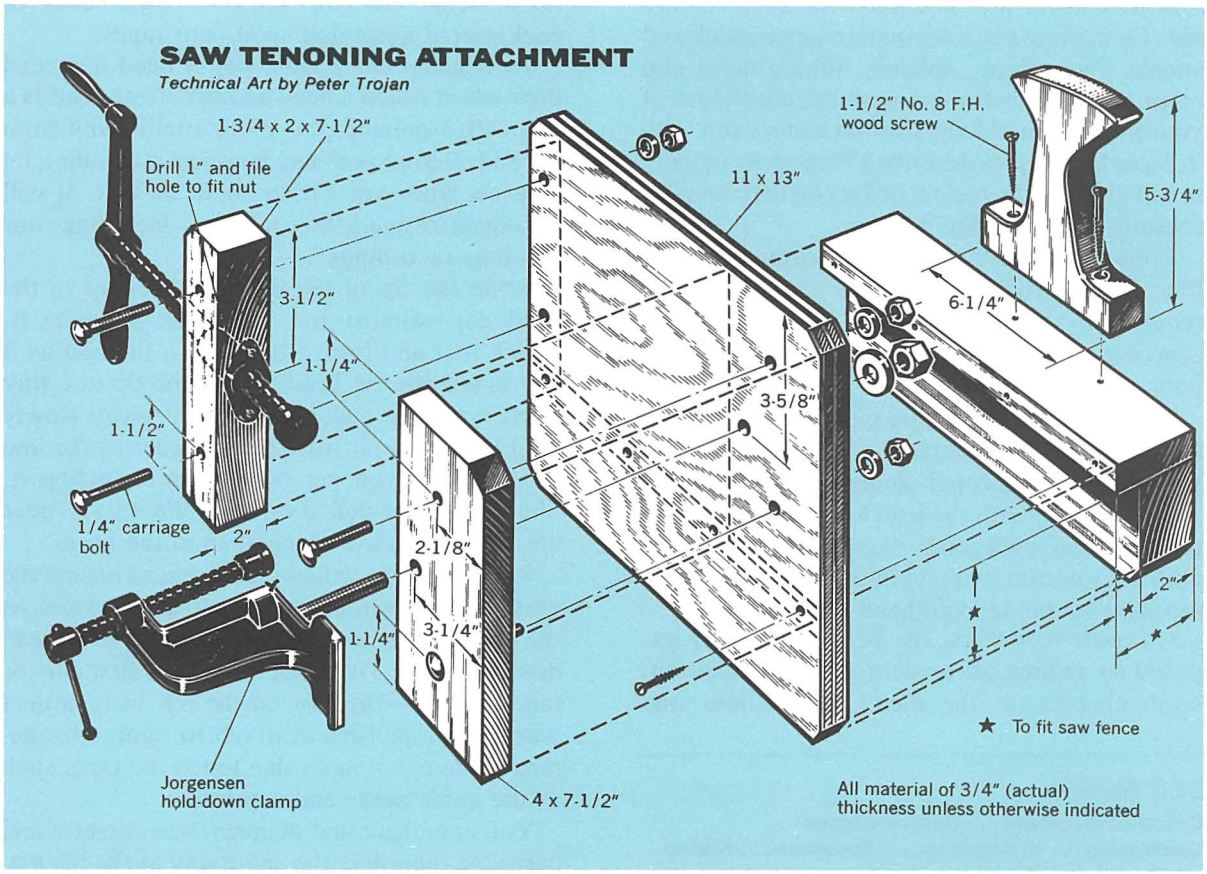
HANDLE CAN be cut as shown, then shaped and contoured to provide comfortable grip when using the rig.

the mounting bolt comes with the clamp). Both clamps are available from woodworker supply houses such as Craftsman Wood Service, 2727 South Mary St., Chicago, IL 60608.

To finish my attachment, I simply rubbed a liberal coating of Trewax Carnauba Plus (wax) into the wood surfaces.

Both "stub" (two cheeks) and "true" (four cheeks) tenons can be cut with the attachment. To make the additional cheek cuts required for the true tenon, merely rotate the stock in the clamps.

In some instances (depending on the stock being cut) the rear clamp alone may be used to hold the stock in place. In these cases the front clamp can be removed to make the attachment lighter to push. Now, you'll be able to cut tenons in production fashion.



Simple periodic maintenance jobs you can do yourself will give you better sound and keep serious trouble from developing. Here's a rundown on products that are readily available to make the task easy and fun

By WALTER SALM

Keep your tape recorder in tip-top shape

TAPE RECORDERS need more care than you may realize. Two absolute musts, for instance, are regular head cleaning and head demagnetizing. Depending on how much you use your machine, these jobs may have to be done as often as once a week. Keeping the heads in good shape will improve your sound and prevent serious trouble later on.

Hi-fi dealers are stocked with many handy aids for making recorder maintenance quick and simple. In addition, splicers, timing tapes and other accessories can increase the usefulness of your machine and help you have more fun with it. Most techniques described here apply equally to full-size reel-to-reel recorders on their smaller cassette and cartridge cousins.

Frequent head cleaning is important because fine oxide particles rub off the tape, leaving a reddish dust on the heads. As this builds up, it can clog critically tiny head gaps, resulting in poor recordings.

Special head-cleaning fluid is available with an applicator brush attached to the bottle cap. Or you can buy isopropyl alcohol at a drugstore. Apply cleaner with the brush supplied or a cotton swab and rub it gently over the heads. Follow with a dry cotton swab, being careful not to poke too hard at the delicate head gaps.

On most recorders, the heads are easily exposed by pulling off a cover plate. In addition, swab cleaner on the metal tape guides and capstan spindle. Do not get any on the rubber pressure roller; it may cause the rubber to deteriorate.

Demagnetizing the heads, called degaussing, is necessary because they are electromagnets and gradually build up some residual magnetism of their own. This is permanent magnetism—different from the heads' changing electromagnetic fields. It can cause a high level of background noise and spoil your tapes.

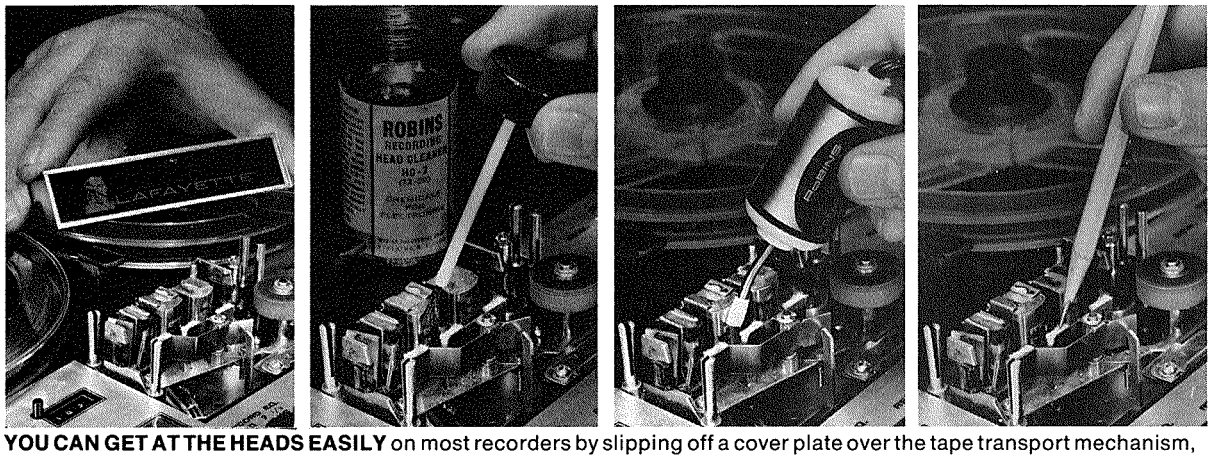
To degauss the heads, you'll need a special instrument called a head demagnetizer. This is a coil with a pointed pole piece sticking out from the end. Before you plug it into an a.c. outlet, be sure no tapes are within about 20 feet. It will demagnetize everything in sight—including your precious recordings.

Bring the tip of the demagnetizer up to the head gap—almost but not quite touching it. You'll feel and hear a buzzing in the coil as it interacts with the head. Wave the tip in a tiny circle over the gap, then back it away slowly until you're as far from the recorder as the line cord will let you get before disconnecting it. Shutting off the coil abruptly while it's still near the head can leave magnetism in the head.

Repeat the procedure for each head except the erase head. It's not necessary to degauss this, as the bias voltage used for erasing keeps the head demagnetized. The erase head is the first one the tape reaches—the one on the left in recorders where the tape runs from left to right. Also demagnetize metal parts that touch the tape, such as the guide posts and capstan.

You can clean and demagnetize cassette and cartridge recorders the same way as the big ma-

SEE ALSO
Cassette recorders . . . Cassette tapes . . . Electronics . . . Hi-fi centers . . . Speakers . . . Stereo



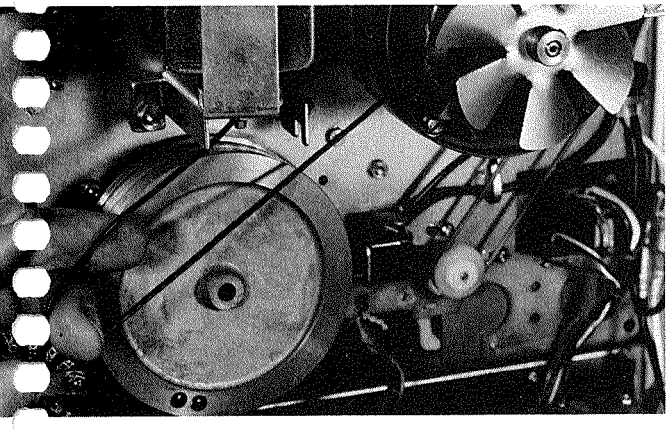
YOU CAN GET AT THE HEADS EASILY on most recorders by slipping off a cover plate over the tape transport mechanism, as shown at the far left, above. With the parts exposed, carefully brush a liquid cleaner on the heads and tape guides, wiping away dust and dirt (second photo from left). Some makes of cleaner come with an applicator brush, as here, or you can use cotton swabs. Keep the cleaner off the large pressure roller or it may deteriorate the rubber. After this, demagnetize the heads using a special prong-tipped coil (third photo from left). Bring the tip close to each head without actually touching the metal, then slowly back it away. At far right, the pencil indicates tiny felt pressure pads that frequently wear down or fall off. Replace these with fresh felt, available in adhesive-backed sheets. Cut small pieces the same size and just press them gently onto the metal pressure fingers. This kind of inspection and maintenance should be performed at regular intervals to keep your machine running smoothly.

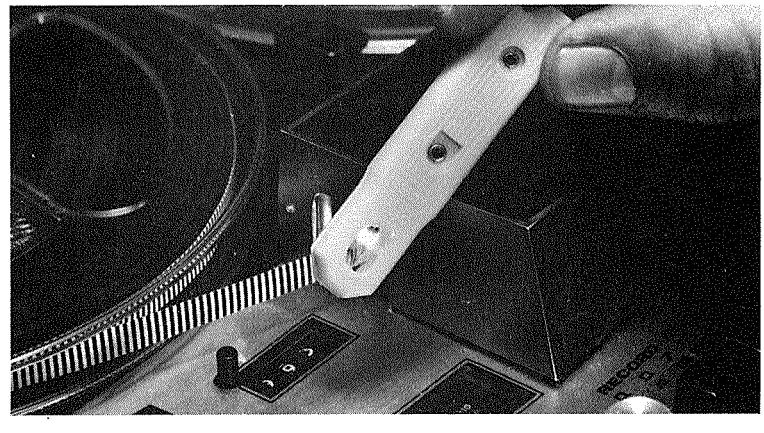
chines, but be careful of the tiny, delicate heads. Usually not as accessible, they must be approached cautiously. While cleaning with a liquid solvent is best, you can get a special head-cleaning tape in cassette or cartridge form that wipes away dirt as it passes the heads. You put it on and let it run as if you were playing a regular cassette or cartridge tape. For automobile cartridge players, there's a head demagnetizer that plugs into the cigaret-lighter socket.

While you're working around the transport mechanism, examine the pressure pads that hold the tape against the heads in reel-to-reel recorders. These are small bits of felt cemented onto spring-loaded metal fingers, one for each head. In time, the felt wears down or comes off and must be replaced to keep the metal from scratching the tape. Replacement felt is available in a self-sticking, adhesive-backed sheet. You just cut off whatever size pieces you need with scissors and press them onto the metal fingers.

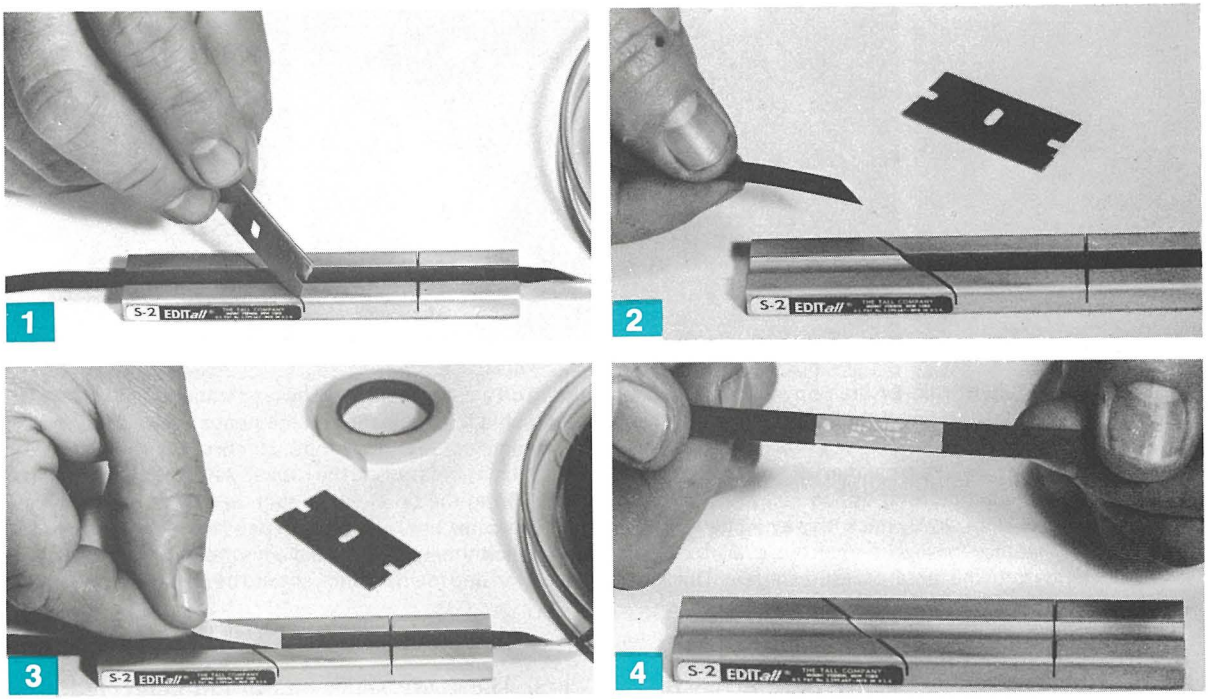
Also subject to periodic failure are rubber drive belts and drive wheels. Heat and age cause the rubber to dry out and lose its resiliency. Belts stretch and slip. Wheels get hard and bumpy. The results are erratic tape speeds, wow and sloppy takeup or rewind.

RUBBER DRIVE BELTS stretch with age and slip, causing erratic tape speeds. Check belts to see if tension is good, as shown at left, below, and replace any that are weak. A stroboscopic speed tester, like the one shown below, right, can also help you check the recorder's accuracy. This one is sold by Robins. A special timing tape with black bars is viewed under a small strobe light. The speed is correct if the bars appear to stand still. If they creep forward, the machine is fast; if backward, machine is slow.





How to use a splicing block



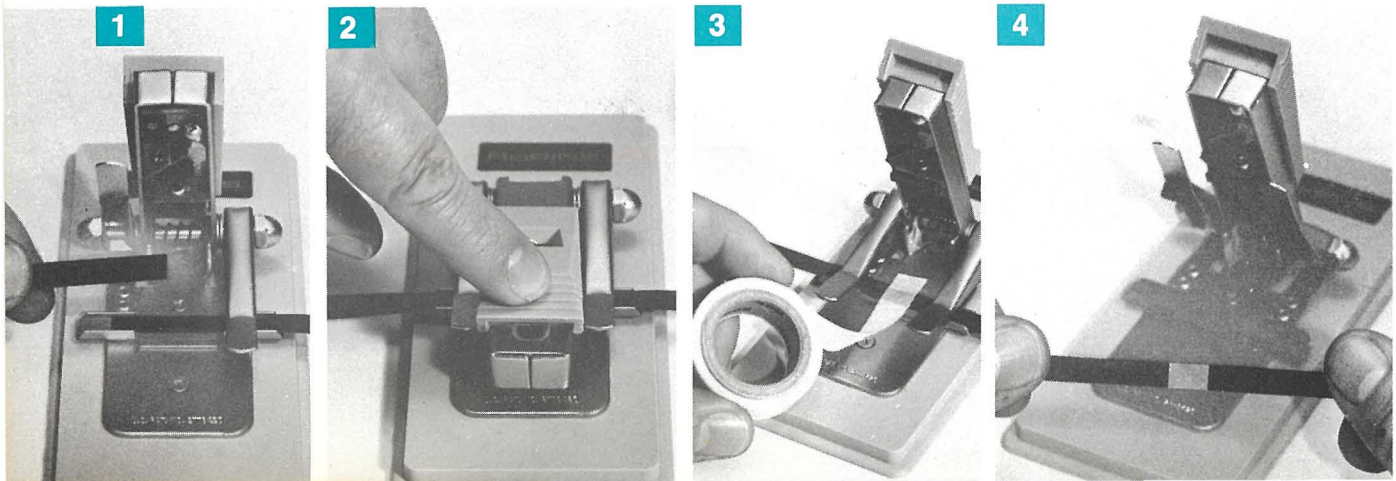
THE SIMPLEST SPLICING TOOL is a slotted block for making cuts with a razor blade. The tape is first cut at the desired point, using the diagonal slot to guide the blade (1). The ends, butted together, are held in the block's groove as splicing tape is pressed over the joint (3). Splicing tape is $^{7}/_{32}$ inch wide—slightly narrower than ¼-inch recording tape—so it can't interfere with the transport mechanism (4). It's placed on the underside of the joint, away from the heads. The Editall block shown is made by Elpa Marketing, New Hyde Park, NY.

Replacement belts and wheels are available from recorder manufacturers for most models. Installing them is easier on some machines than others. You will first have to remove the tape chassis from its case or base to get at the back. With the chassis exposed, run the machine through its various functions to see if you can spot which belts or wheels are slipping. On some models, new belts and wheels can be put on without disturbing the rest of the machinery. Others may require a major disassembly. If you aren't sure how to proceed, leave this job to a repairman.

Worn connector cables are a major source of grief with tape recorders just as with other hi-fi components. Check for fraying or looseness at the plug ends and replace any cables that show wear.

THE SPLICING MACHINE cuts and joins tape automatically. Tape ends are overlapped under the hinged cutter and held in place by spring-loaded fingers (1). Pressing the cutter down (2) slices through both tapes, leaving the ends butted together. The splicing tape is then applied to the joint (3) and the cutter is pressed again, this time trimming off the excess splicing tape to make a neat splice (4). Wide splicing tape is used in this method since it's put on crosswise. The splicer shown is made by Robins, Flushing, NY.

How to use a tape splicer



Editing your tapes can add a lot more enjoyment to your recording. You can cut out bad portions and save only the good. You can group similar selections together so a whole collection is instantly available—say, a reel of popular music, a reel of classical, a reel of show tunes and so on.

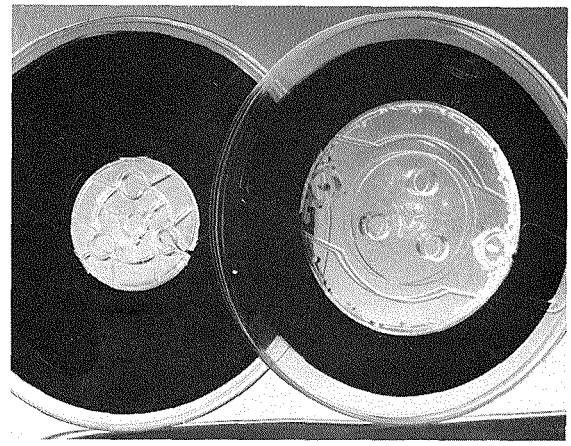
For editing tape, you need a splicing aid. The two basic types are the splicing block and the splicing machine. The block is simplest and costs only a few dollars. The machine splicer, a little more expensive, requires less skill and is faster.

The accompanying photos show how each type of splicer works. In either case, the tape is sliced diagonally instead of straight across. This allows the joint to pass over the heads progressively, instead of abruptly, and lessens the chance of sudden annoying noises. The joint is held together by special splicing tape. Ordinary cellophane tape won't do because it shrinks and gets tacky with age.

In addition to editing, you'll need a splicer for repairing broken tapes and adding blank strips of leading and trailing tape at the ends of a reel. Leaders and trailers make tape handling easier and protect the ends, which otherwise tend to break off a bit at a time as the tape is played. Another use for such strips is to splice in "pauses" between recorded passages—short lengths of blank tape that help to keep your musical selections from running together. One blank tape made by 3M Co. (Scotch Brand) has timing marks one second apart at a tape speed of 3¾ or 7½ inches a second. By counting the marks, you can insert pauses timed precisely to any number of seconds you want.

As part of your program for regular tape care, run seldom-played tapes through your machine once in awhile to exercise them. You can do this at a fast wind if you don't care to take time to listen. Unless tapes are run occasionally, they may take a "set" and become brittle. Worse, some print-through may occur. This is when the recorded material on one tape layer makes a slight "print" or magnetic impression on the next layer. As a result, you may hear an annoying pre-echo of loud passages before they're due.

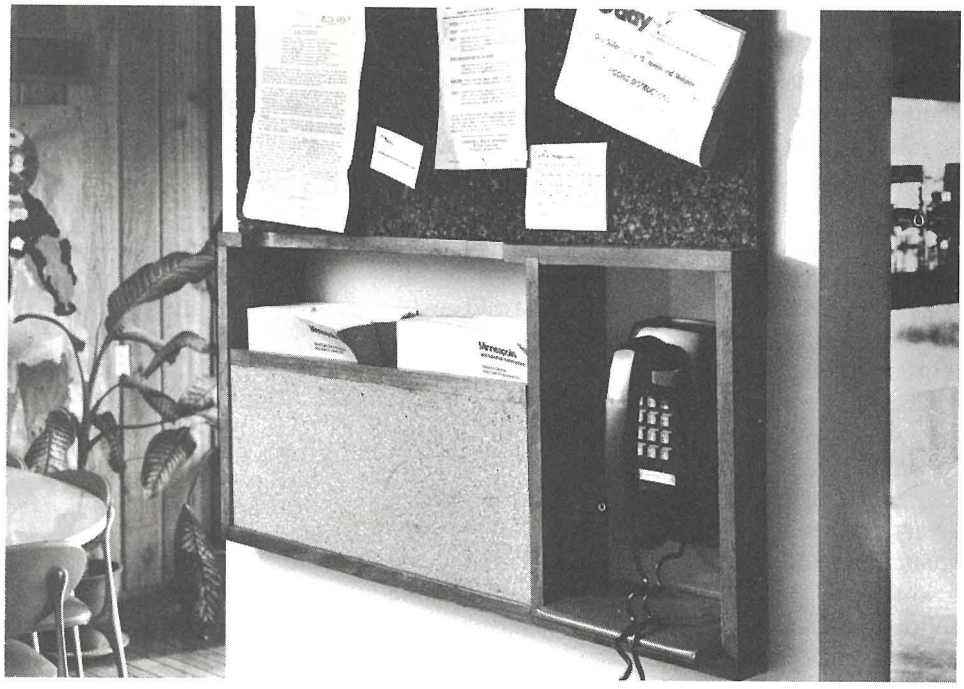
Recording supplies and accessories are available individually and in handy kits. Some best-known names are the Robins line, Robins Industries Corp., 15-58 127th St., Flushing, NY; the Ultima line, Ehrenreich Photo-Optical Industries, Inc., 623 Stewart Ave., Garden City, NY; and the Editall line, Elpa Marketing Industries, Inc., New Hyde Park. NY.



THE LARGE-HUB REEL at the right above offers more even takeup tension, but doesn't hold as much tape as the standard reel. It's useful for editing short tape passages.

HANDY HEAD-CLEANING TAPES are designed for small cassette and cartridge recorders where heads may not be easily accessible. You just play the tape and it polishes the heads clean.

TIMING TAPE made by 3M Co. has identification marks every 3¾ and 7½ inches. These marks are one second apart so you can splice in accurately timed pauses.

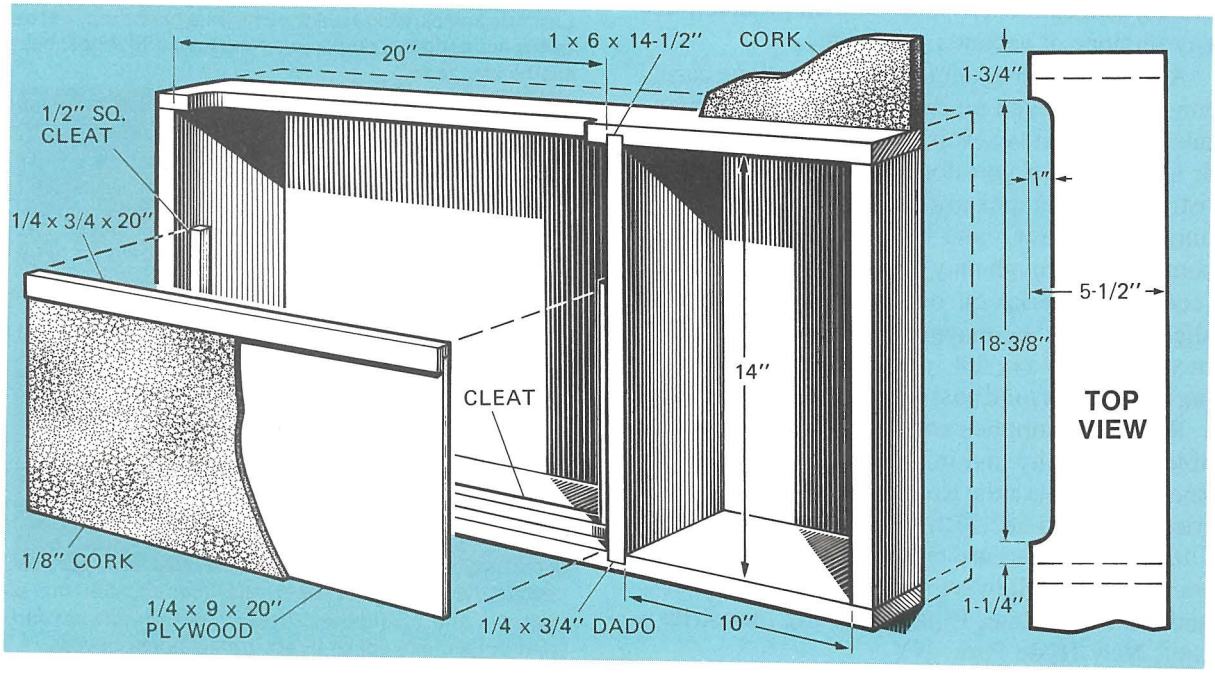


Message center holds phone books

■ MOST TELEPHONE message boards forget the directories, but not this one. It has a pocket big enough to hold two big-city books.

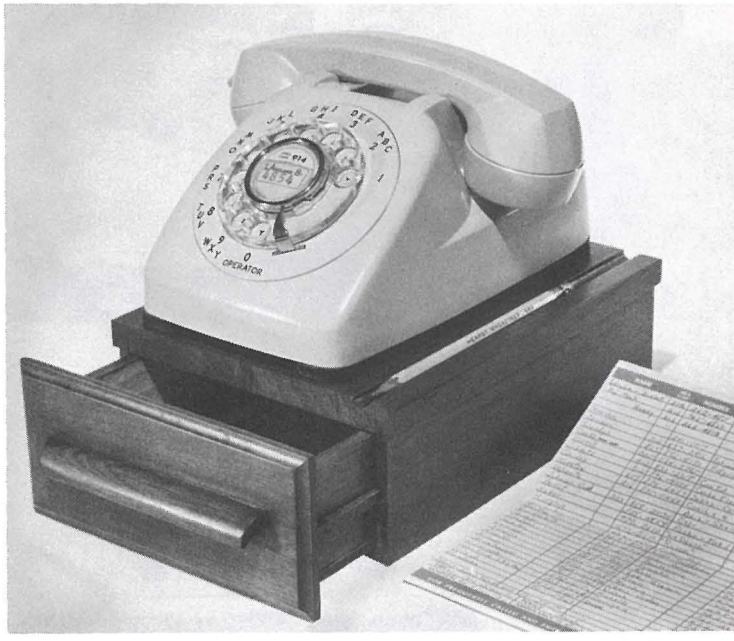
Architect Russell Zenk designed it for homeowner Peter Briggs of Minneapolis who built it into a floor-to-ceiling island wall that divides the kitchen.

The simple box frame is made of 1 x 6 stock fitted with a back and set into the wall to project about 2½ in. Thick insulation cork is cut to fit the length of the cabinet and fastened to the wall above it. A thinner piece of cork is glued to the front of the telephone-book pocket. While the original frame was built in, it could be made shallower and surface-mounted. In this case, no back is needed.



Telephone caddy

By ELMER E. SCOTT



HOW MANY TIMES have you wanted to jot down a telephone message only to find no pencil or paper handy? It won't happen with this telephone caddy. Serving as a base for a cradle phone, it is fitted with a drawer for pad and phone list, and a pencil groove.

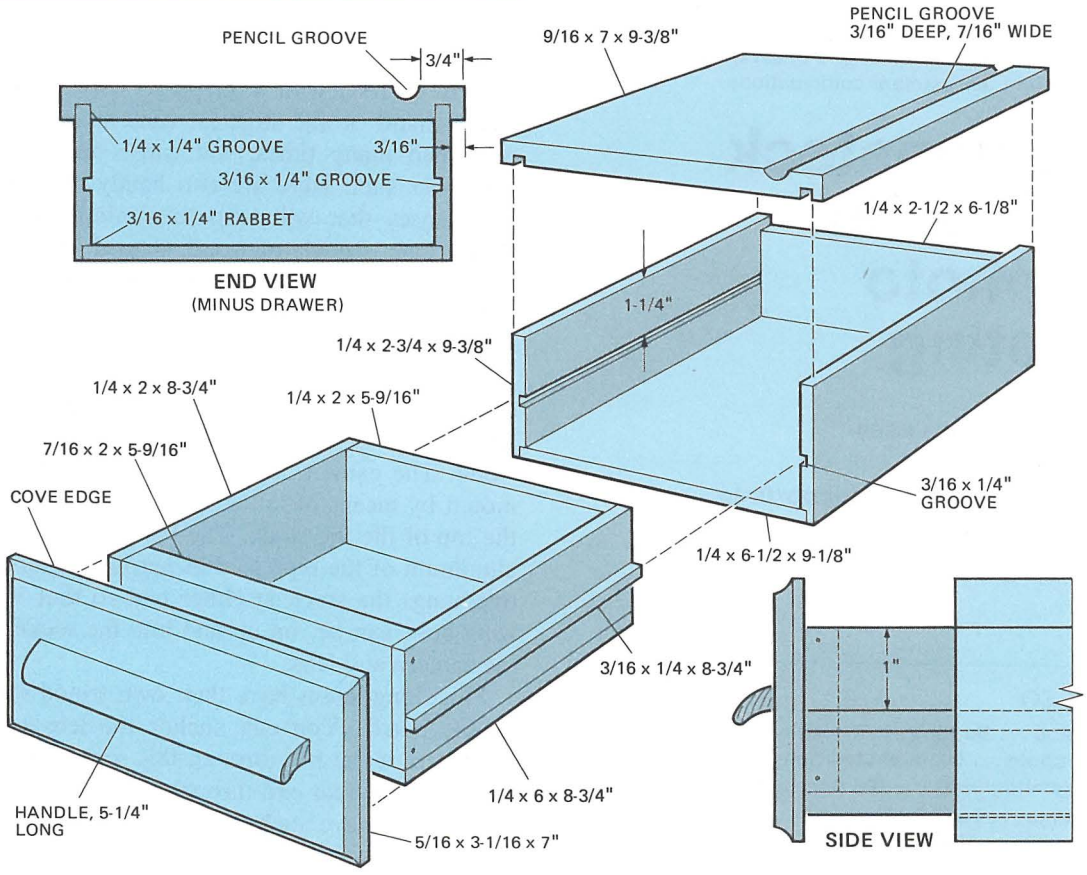
Both the bottom of the box and the back of the box are housed in rabbets cut in the side members. Those housing the back are blind rabbets which stop ¼-in. from the top. The 3/16 x ¼-in. grooves for the drawer guides are run, of course, before final assembly. The top of the box, grooved to fit over the side members, butts the top of the back.

While dimensions are given for the drawer, the job is to fit it so it slides easily into the box. The lipped drawer front laps all four edges of the box flush.

After the box is assembled, finish it to suit your personal taste.

SEE ALSO

Drawers . . . Kitchen accessories



STANDARD RIFLE SLING can be added if you like, but is not essential. Note how the cable release is attached to the stock's hand grip so you can operate it like the trigger on a gun.

GUNSTOCK MOUNT is easily jigsawed to shape from plywood or solid stock. The aluminum bar on which the camera is mounted can be drilled at several locations to suit different lens-camera combinations.

Two gunstock mounts for telephoto shooting

By SHELDON M. GALLAGER

These handy camera supports to help steady a long lens give you a choice of wood or pipe construction

SEE ALSO

Bird photos . . . Boating photography . . . Lenses, photo . . . Night photography . . . Outdoor photography . . . Photography . . . Photo hints . . . Telescopes . . . Testers, camera shutter-speed

SHOOTING with a telephoto lens requires a steady hand or the slightest camera movement, magnified many times, will cause blurring and ruin your shot. Here are two handy mounts for long lenses that will help to minimize camera shake. One is made of wood, shaped like a gunstock, and the other uses pipe fittings with hand grips. You can pick the type that best suits your particular needs.

The gunstock mount shown on this page was designed by R. S. Hedin. It's a simple cutout jigsawed from ¾-inch plywood or solid hardwood. The camera and lens are fastened to the mount by means of an aluminum bar screwed to the top of the the stock. The bar is ¾-inch-wide aluminum of the type sold in hardware stores. It overhangs the stock at either end so that ¼-20 wing bolts can be run up and into the sockets on the camera and lens.

Most long lenses have their own tripod socket on the barrel. You can anchor the lens to the front end of the bar through this socket and the camera to the rear end through its socket. If your lens doesn't have such a socket, you can lash it to the bar with a large hose clamp. Pad the

clamp with a strip of felt or rubber innertube to keep it from marring the lens. A cable release is held in a clip on the hand grip so you can work it just like a trigger on a rifle. You can shape the clip from a small piece of steel strap hacksawed from a metal corner angle. A cutting diagram for the stock is provided.

The pipe-frame cradle was designed by Walter E. Burton. It can be either hand-held or mounted on a tripod. The front support slides on the main pipe rail so it can be easily adjusted to suit lenses of different lengths. The arrangement is especially helpful for supporting lenses not originally intended for use on a camera, such as a telescope, spotting scope or field-glass monocular.

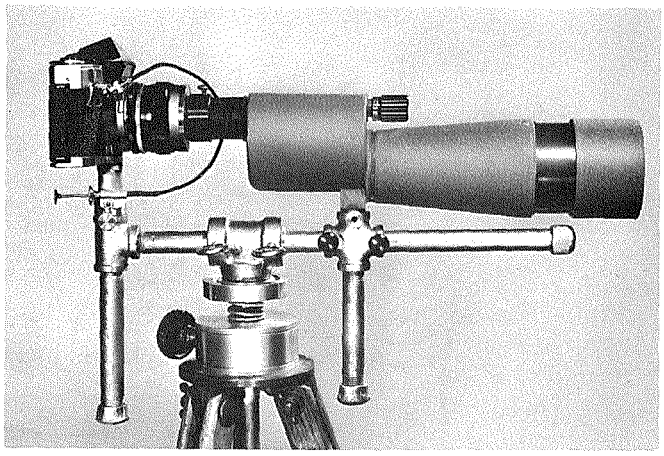
fittings are standard

All fittings are standard ⅜-inch pipe except for the central tripod support, which is a ½-inch tee. The tee slides on the rail so the entire cradle can be moved forward and backward or rotated sideways to turn the camera vertically. File away the threads in the two opposing arms of the tee and make a split sleeve of sheet brass or other metal to fit between the tee and the rail. Drill and tap the tee for two ¼-20 wing bolts to lock the tee on the rail. Insert a pipe plug in the lower opening, saw it off flush and run a ¼-20 tapped hole through it for attaching to the tripod screw.

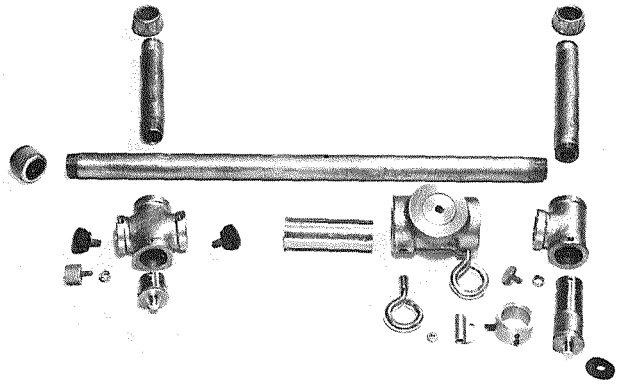
The posts that support the camera and lens can be machined from solid stock, as shown in the drawing on the following page, or they can be short lengths of pipe. The important thing is that they must be removable so they can first be screwed into the camera and lens sockets and then slipped into the cradle. For this, remove the threads from the upper openings in the front and rear fittings to make a smooth, sliding fit for the posts.

If you use pipe sections for the posts, screw pipe caps onto the upper ends and drill and tap the caps for ¼-20 bolts run up from the inside. Tighten the bolts snugly against lock washers so they can't loosen. The threaded shanks extending up through the caps are then screwed into the sockets in the camera and lens. The lower ends of the posts should be unthreaded so they'll slip easily into the reamed openings in the cradle fittings. The posts are locked in place by setscrews.

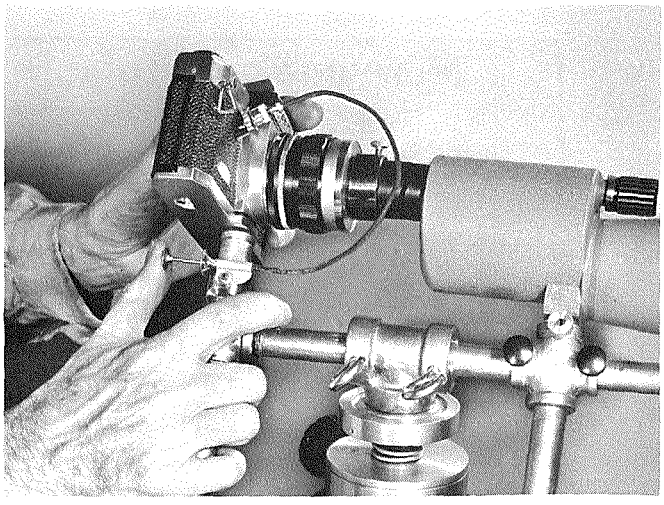
The two side openings in the four-way fitting must be reamed or filed out so the piece will slide on the rail. This type of fitting, called a cross, may not be readily available at plumbing stores, but



ADJUSTABLE PIPE cradle makes it easy to attach lenses of different lengths to a camera. It can be held by hand grips or mounted on a tripod as shown here.



ALL PARTS are standard pipe fittings except for the posts that support camera and lens. These are shown machined here, but can also be made of pipe.



SWIVEL ACTION of tripod support permits entire cradle to tilt sideways for shooting with camera turned vertically. Wing bolts lock the cradle in place.

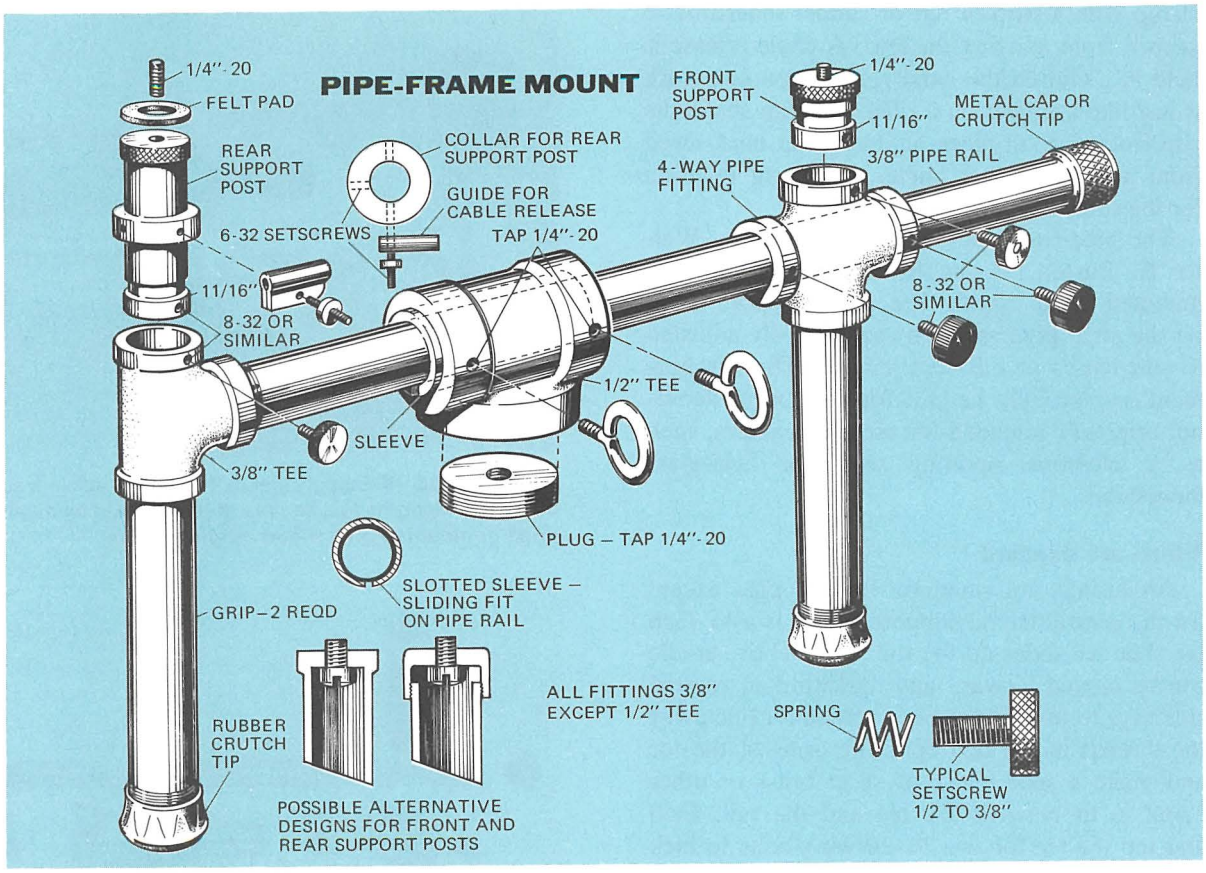
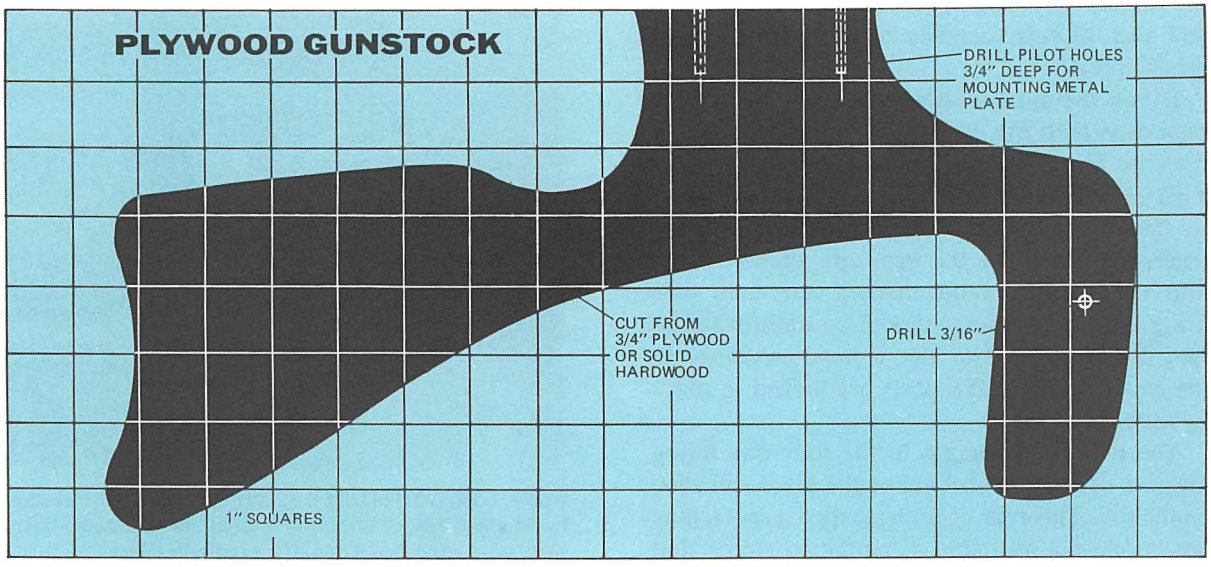
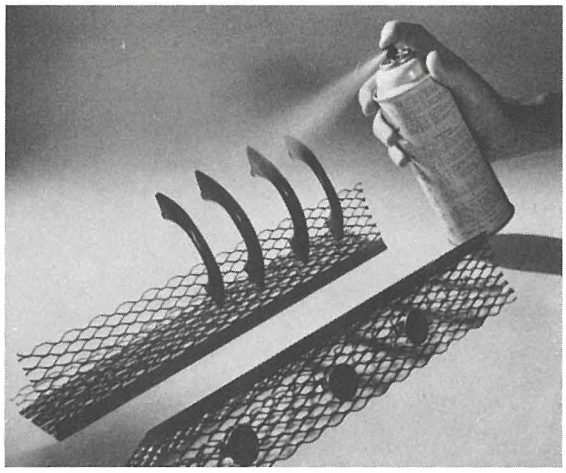


photo gunstock mounts, continued

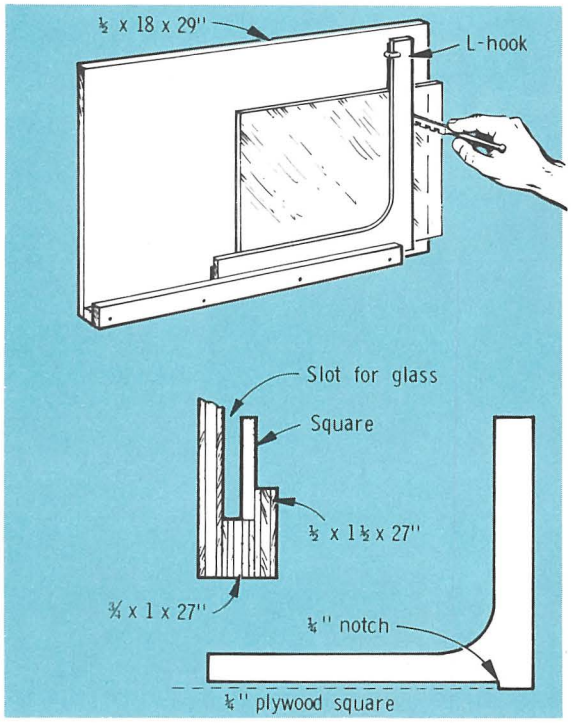
can be obtained from building-supply dealers or shops that make pipe railings.

The release cable is clamped in a guide on the rear post so you can operate it with your thumb while holding the rear hand grip. The length of the main rail is determined by the amount of travel you want. That shown is 12 inches long.


PLYWOOD GUNSTOCK
DRILL PILOT HOLES 3/4" DEEP FOR MOUNTING METAL PLATE
CUT FROM 3/4" PLYWOOD OR SOLID HARDWOOD
DRILL 3/16"
1" SQUARES



CORNER BEADING scraps left over from a plastering job make ready-made holders for small parts such as knobs and pulls. Whether you lay the scraps on their side or stand them upright, they provide handy racks for the parts while you spray-paint and dry them.—*Gene Rapp.*

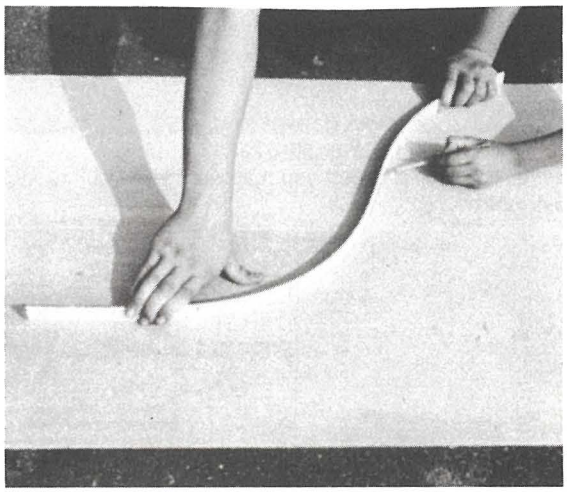


CUTTING GLASS squarely is no problem when you have this handy cutting board mounted on your shop wall. Its built-in square helps hold the glass and assures a right-angle cut every time.

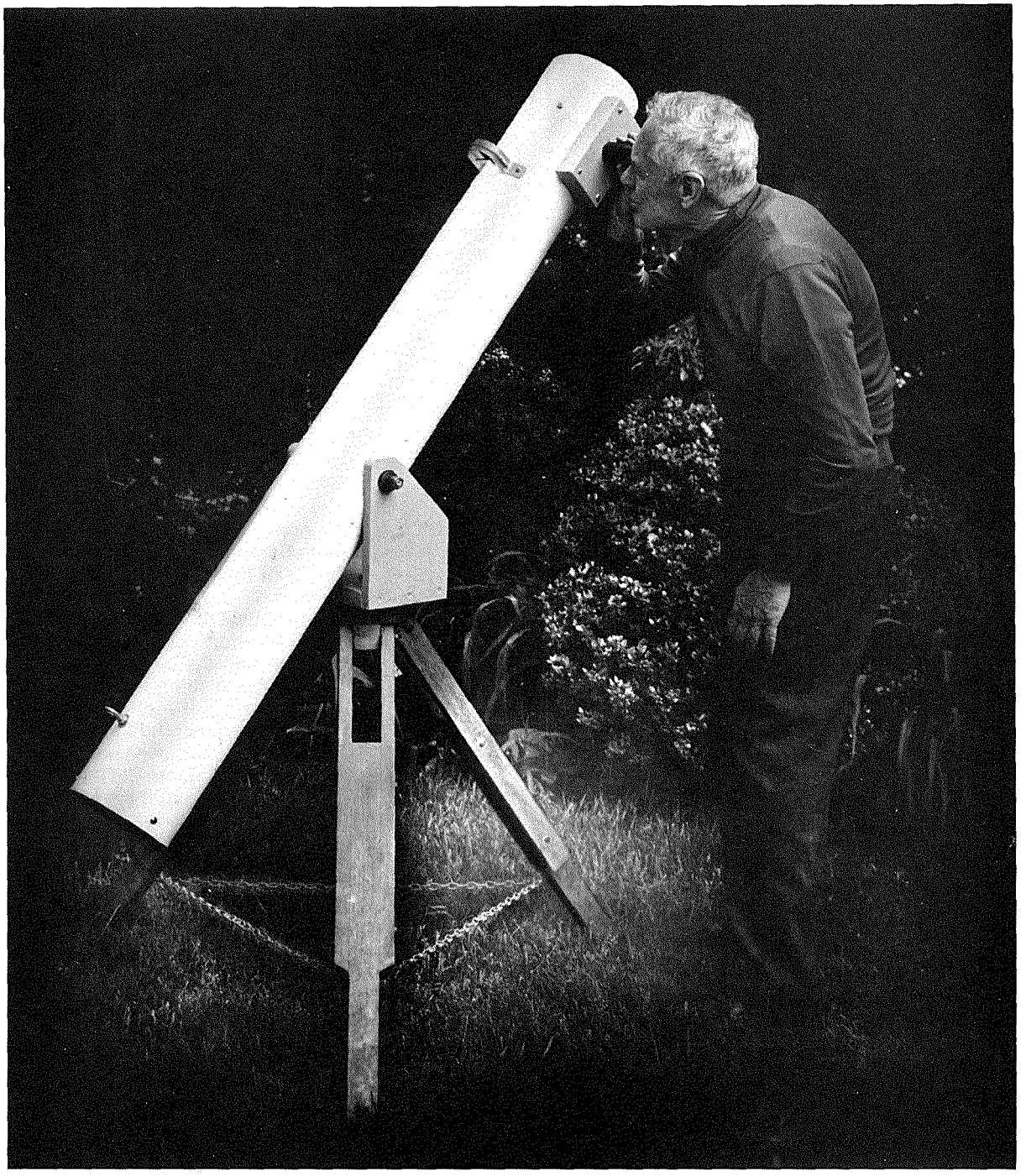
To make it you start out with a flat panel of plywood and add a trough along the bottom edge. This is formed with two strips, one wider than the other.

The square, which provides a straight-edge for the glass cutter, is cut squarely from ¼-inch plywood to slide freely in the trough, and is notched along the bottom. The notch helps hold the square in place at the bottom, while an L-hook serves to clamp it at the top. A steel carpenter's square will save you the trouble of making a square and then having to worry whether it is square.

The glass is all you need to hold when drawing the cutter along the guide. With the glass held vertically, you'll find it easier to make a clean score than when it's cut on a flat surface.—*G.E. Hendrickson.*



A SCRAP of decorative laminate will help you draw a large irregular curve. Ripped into a long strip about ½ inch wide, the laminate is an improvement over wood strips for drawing curves. It's flexible enough to assume the shape of almost any curve and the plastic is as strong as is needed. One drawback is that it takes three hands to use it, but with the assistance the job is quick and easy. If there's no one available to help, you can place weights alongside the strip to hold a curved position.—*Rosario Capotosto.*



THE FINISHED telescope is capable of serious astronomical work with power ranging from 50 to 200X. The power is dependent upon the eyepiece you chose to use with your telescope. The first object you may want to see is the moon. For best viewing, always wait until it is at first or last quarter.

SEE ALSO
Discs, wood . . . Fasteners . . . Hobby centers

Build a 200-power telescope

By ROBERT BRIGHTMAN

You can make this strong, sturdy 'scope for a fraction of the cost of a factory-made model. It will take some time and patience to grind and polish the mirror until it is perfect, but once you finish it and mount it in a barrel and tripod, you will be hooked on star-gazing forever

■ THOUGH SURPRISINGLY EASIER to build than a quick glance might imply, make no mistake about it: This version of a 200-power telescope is not a toy. With it, serious students of astronomy will be able to study craters on the moon, Saturn's rings, the polar caps on Mars, the satellites of Jupiter and giant nebulae. And just for the fun of it, you'll win the wager if you claim that you can read the time on a pocket watch or a newspaper headline a mile away.

The heart of the telescope is a 6-in. mirror. It's fashioned from a mirror kit and is available by mail order from Edmund Scientific Co., 380 Edscorp Building, Barrington, NJ 08007. Additionally, you'll need a length of aluminum tube (7 in. o.d. x 60 in. long). You will also need miscellaneous hardware and wood for the tripod. Totaled up, your $50 to $75 cash outlay will let you turn out a finished 'scope that is easily the equal of those selling for $250 and up.

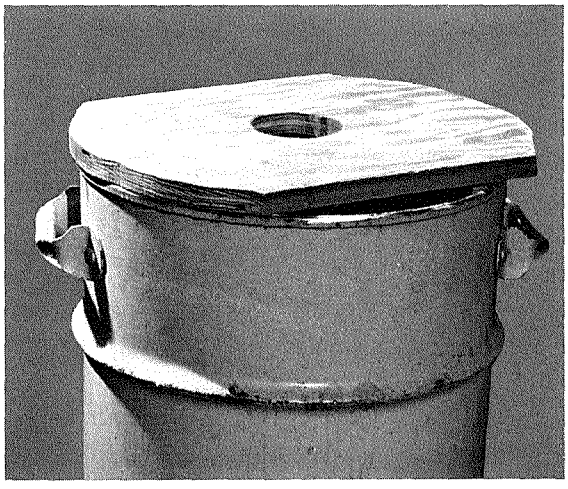
For comfort, cut the barrel workbench so that the work surface is 33 in. from the floor. The reason a barrel is best is that grinding and polishing necessitates walking around the workpiece.

Cement a handle to the back of each glass disc. The wooden cores used in wrapping paper rolls are ideal for this purpose. Melt some pitch in a can, swab the surface of each disc with a little turpentine and pour some of the melted pitch over the glass. Then, quickly center the wooden cores in the middle of each disc. The 1-in.-thick disc will now be referred to as the mirror and the thinner disc as the tool. Next, cut a hole in the barrel top large enough to accept the handles.

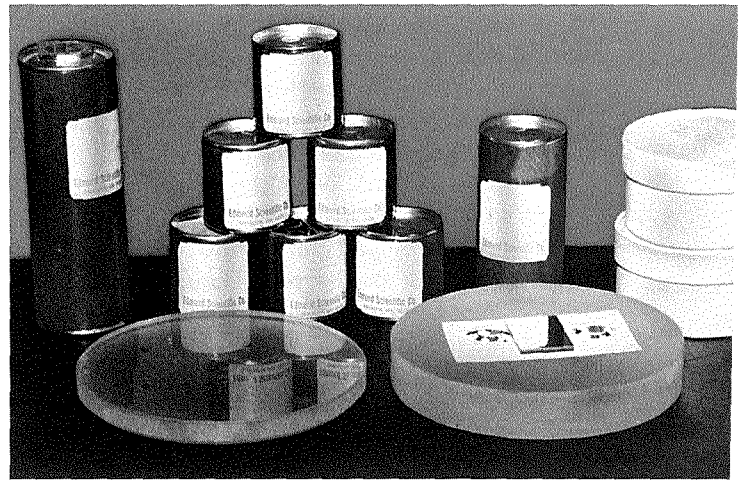
Supply yourself with a jar of clean water and an eyedropper forced through a cardboard cover to keep out any dust. The grinding abrasives are packed in shaker-top containers labeled 80, 120, 220, 320, 400, 600 and emery. Cut several cardboard collars to fit over the handle of the mirror and use a fresh one every time you change grit size. Cover the barrel top as shown and insert the tool. (Here, too, replace the rag with each grit change.)

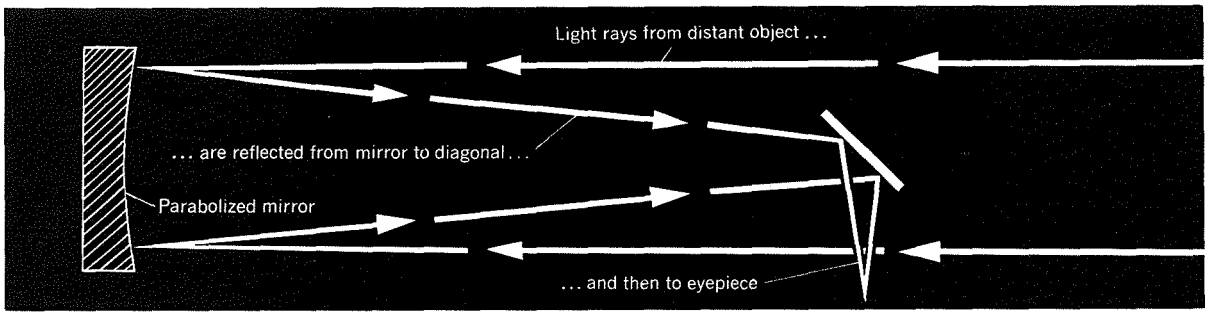
Sprinkle a quarter teaspoon of No. 80 grit over the mirror, add a few drops of water and grasp the mirror as shown. Using short back-and-forth strokes, rub it over the tool. There are three

THE "WORKBENCH" consists of a barrel weighted with 12 bricks, plus a piece of plywood with a hole to receive handle of the tool or the mirror.



MIRROR-MAKING kit consists of two glass discs, a diagonal mirror, two eyepiece lenses, seven grades of grinding compound, rouge and pitch.





THIS LINE DRAWING shows the operation of the telescope. Light rays are reflected from a distant object off the parabolized mirror to the diagonal and finally to the eyepiece and your eye.

mirror-maker's motions. First, the grinding stroke, which is about 2½ in. forward and back—a total of 5 in. with the mirror overlapping the tool not more than 2½ in. at the end of each stroke. Second, rotate the mirror ⅛th turn every three or four strokes. Last, every few minutes take a step around the barrel.

When the grit ceases to cut (the loud rasping noise diminishes to a swishing sound), add more grit and, if necessary, water. Repeat this step for about two hours. Remove the cardboard collar and wash the mirror. It should have a coarse, ground-glass appearance. Apply a straightedge and check the concave surface.

The amount of curvature to which our mirror is ground is governed by the focal length (48 in.) of the telescope I constructed. In photographer's language it is an f8 mirror (focal length of the mirror is eight times the dia. of the mirror and 48 in. divided by 6 in. equals 8, or f8). But it is an optical law that the radius of curvature of a mirror is equal to twice the focal length. This means that our mirror will have to have a radius of curvature of 96 in. in order to have a focal length of 48 in.

Though you can use a cardboard template to determine this curve, it is so slight that it's possible to be over or under as much as 12 in. and still have the template touching the mirror. After a curve has become apparent and proved with the straightedge, you can determine focal length by the candle method. Wash the mirror and rinse it with water. Move a lighted candle slowly from left to right until you can see the reflection in the wet surface of the mirror. Then, as you move back, the candle flame will grow larger but it will continue to move in the same direction that you move the candle.

At a certain point, when you have moved back far enough, the candle image in the mirror will be upside down and move in the opposite direction from that which you are moving the candle. This means that you have passed the radius of curvature. Walk back to the mirror so that no apparent motion, left or right, is visible when the candle is moved. The mirror at this particular point will appear as a blob of light. It's entirely possible that you may have to move back 20 ft. before this happens. This means you should grind the curve deeper. Continue grinding until the candle test shows that you have reached a curvature of roughly 120 in. At this point the mirror shows an obvious curve when the straightedge is applied. Clean away all traces of the No. 80 grit and wash the mirror, tool and barrel top thoroughly.

Next, repeat the procedure with No. 120 abrasive, shortening your stroke to 2 in. Use the same grinding technique to deepen the curve. Continue grinding until the mirror has a smoother surface and a clearer candle reflection. Stay with the second grit until the radius of curvature is about 100 in.

When you reach the desired radius, move up to the next higher grit. Grind with No. 220 and all succeeding grits, making certain to clean thoroughly between changes. A very smooth, fine-ground finish, which will hasten polishing immeasurably, can be obtained by following up the last grade of grit (No. 600) with emery for an hour.

Polishing. Take the pitch and break it into chunks. Place several pieces in a tin can and, since pitch is flammable, use an electric hot plate rather than an open gas flame as a heat source. Heat the pitch to the melting point without boiling. Carefully clean the tool under running warm water and, when dry, replace it on the barrel. Next, make a cardboard collar for the tool that extends about ¼ in. above the top of the tool. Make it long enough so the ends overlap about 2 in. and hold it fast with tape. Moisten a rag with turpentine and swab the top of the tool.

When the pitch is melted, strain it through four thicknesses of cheesecloth and pour it over the tool. Start at the outside and work toward the center. When the pitch is level with the top of the cardboard dam, stop pouring.

After the pitch cools and hardens, strip away the cardboard. Then sluice the mirror surface with a sudsy solution of soap and water. Carefully lower the mirror over the pitch lap while moving it about the pitch lap in various directions (about an inch each way). This serves to conform the pitch lap to the spherical curve of the mirror. Keep doing this for about 30 minutes, or at least until the pitch starts to spread and form a ridge around the tool. When pitch lap and mirror are well separated by the soap solution, set the mirror and tool aside overnight.

The next day you will find it impossible to budge the mirror. The reason is that the outer edge of the mirror is sunk into the pitch lap. Trim away this excess pitch with a knife moistened in water. With a little pressure in various directions, you will then be able to slide off the mirror.

The next step is to cut the 1¼-in. squares (facets) in the pitch lap with a hacksaw. The pitch will probably splinter a bit leaving the lines ragged. This will not affect the polishing operation. *A word of caution:* The facets must be cut as shown in the drawing. The nearest facet to the center of the tool should be offset about ⅜ in. This is necessary to prevent the mirror from possibly polishing in rings. Moisten the mirror with the soap solution and place it down over the pitch lap. Let it stay this way overnight. Fill a quart bottle about one-third full of warm water and dump the package of rouge into the bottle. Cap the bottle and shake thoroughly.

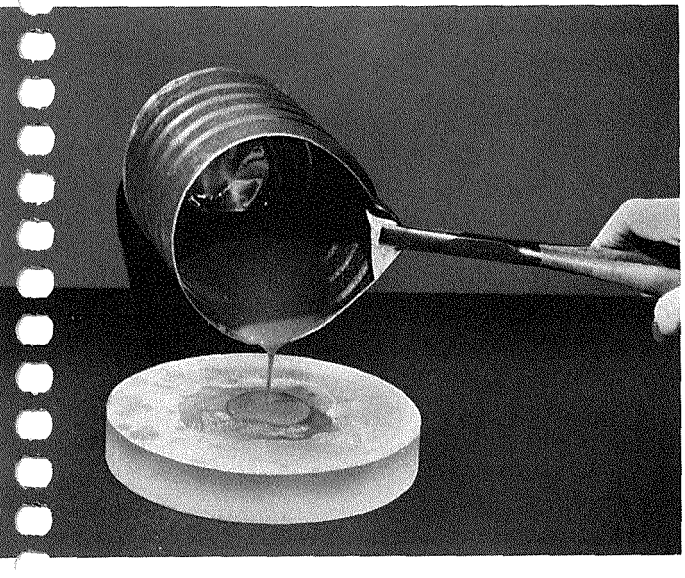
Next you'll need a pound-size jar with a screw lid. After cutting a hole in the lid, force the rubber tip of an eyedropper through it. Over the open jar, place three thicknesses of clean cheesecloth. Shake the rouge solution, pour about half through the cheesecloth and discard the cloth. Stir the rouge solution a bit, and use the eyedropper as an applicator.

Squirt a dropperful of the rouge solution over the mirror and use the same stroke that you used in grinding, 2 in. forward and 2 in. back. You may have to add some of the rouge solution after five or ten minutes of polishing, especially if the mirror starts to stick. You can often eliminate sticking by sliding the mirror off the lap and then bringing it down again. If the mirror persists in sticking, try an application of soap solution, which acts as a lubricant, add some rouge and polish for 30 minutes. Then wash the rouge off the mirror, stand it on end and allow to dry.

Continue polishing until the final pit has disappeared from the edge of the mirror. However, if curious as to how your polishing is coming along, check your work with a Foucalt knife-edge (shadow) test. To do it, you need a razor blade and a pinpoint source of light.

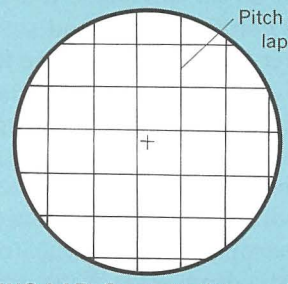
The light source consists of a small candelabra-base lamp mounted on a block of wood. Over this, place a cardboard tube or can with a

TO CEMENT the handle to the disc, melt some pitch in a can, then pour a little on the middle of the disc and center the wood wrapping-paper core.



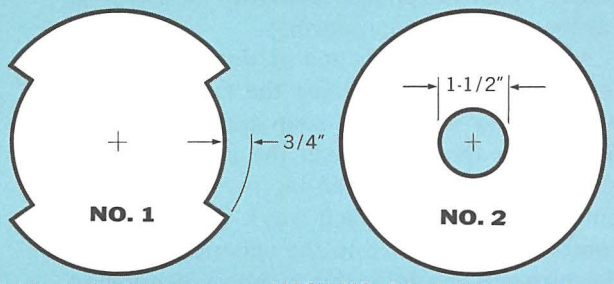
POSITION CLEAN cloth over the barrel and insert the tool with handle into the hole. With mirror held as shown, the initial back-and-forth stroke is 2½ in.

Back-Yard Telescope



POLISHING LAP. Cross marks the center of the lap. Note no channels intersect at center, no facet is in exact center.

EYEPIECE MASKS

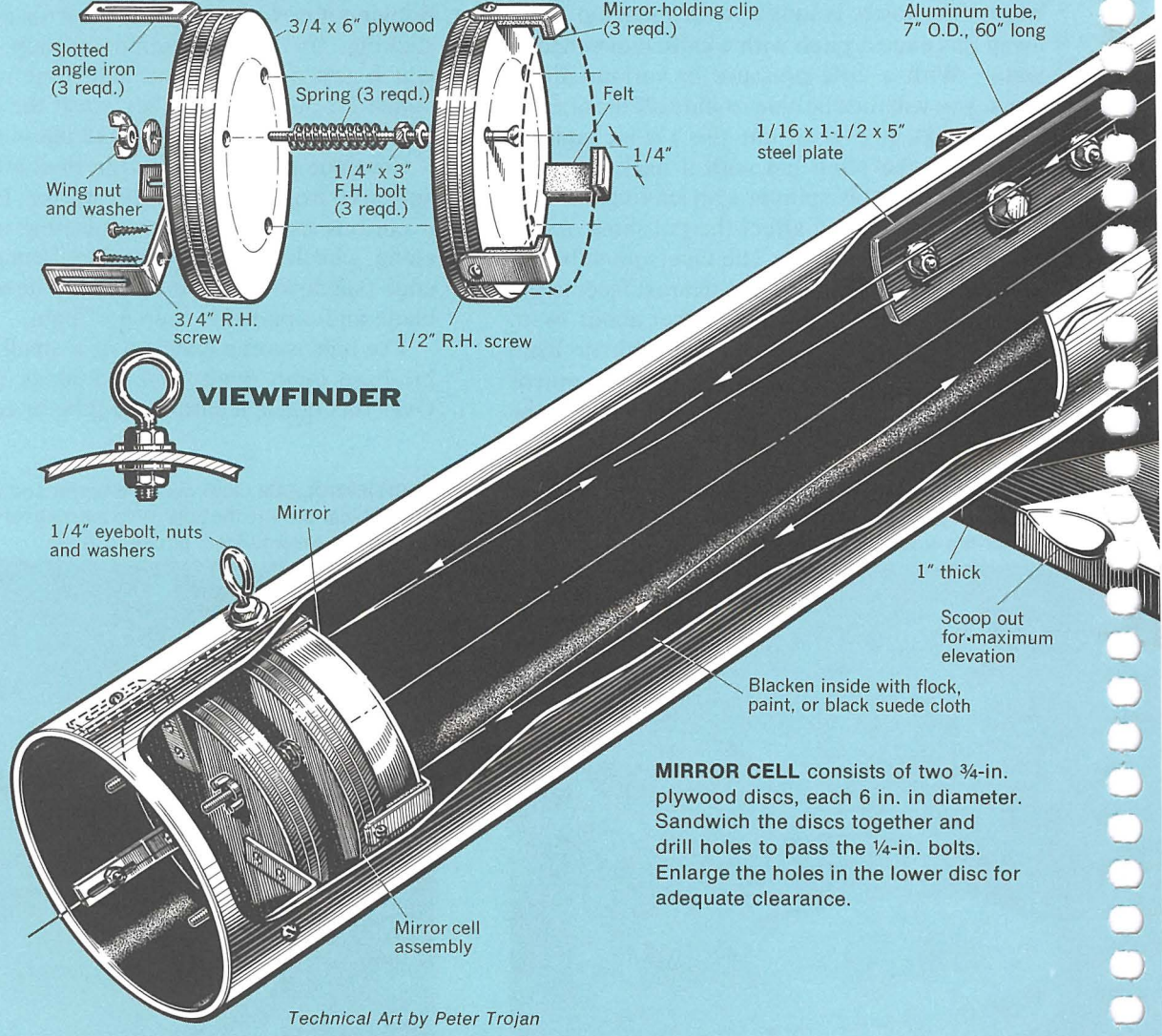


MASK NO. 1 is used to test outer zone of mirror. Cut it of stiff cardboard and tape it to mirror edge.

MASK NO. 2 tests inner zone of mirror. As indicated in text, there should be a difference of $^{1}/_{10}$ in. between zones.

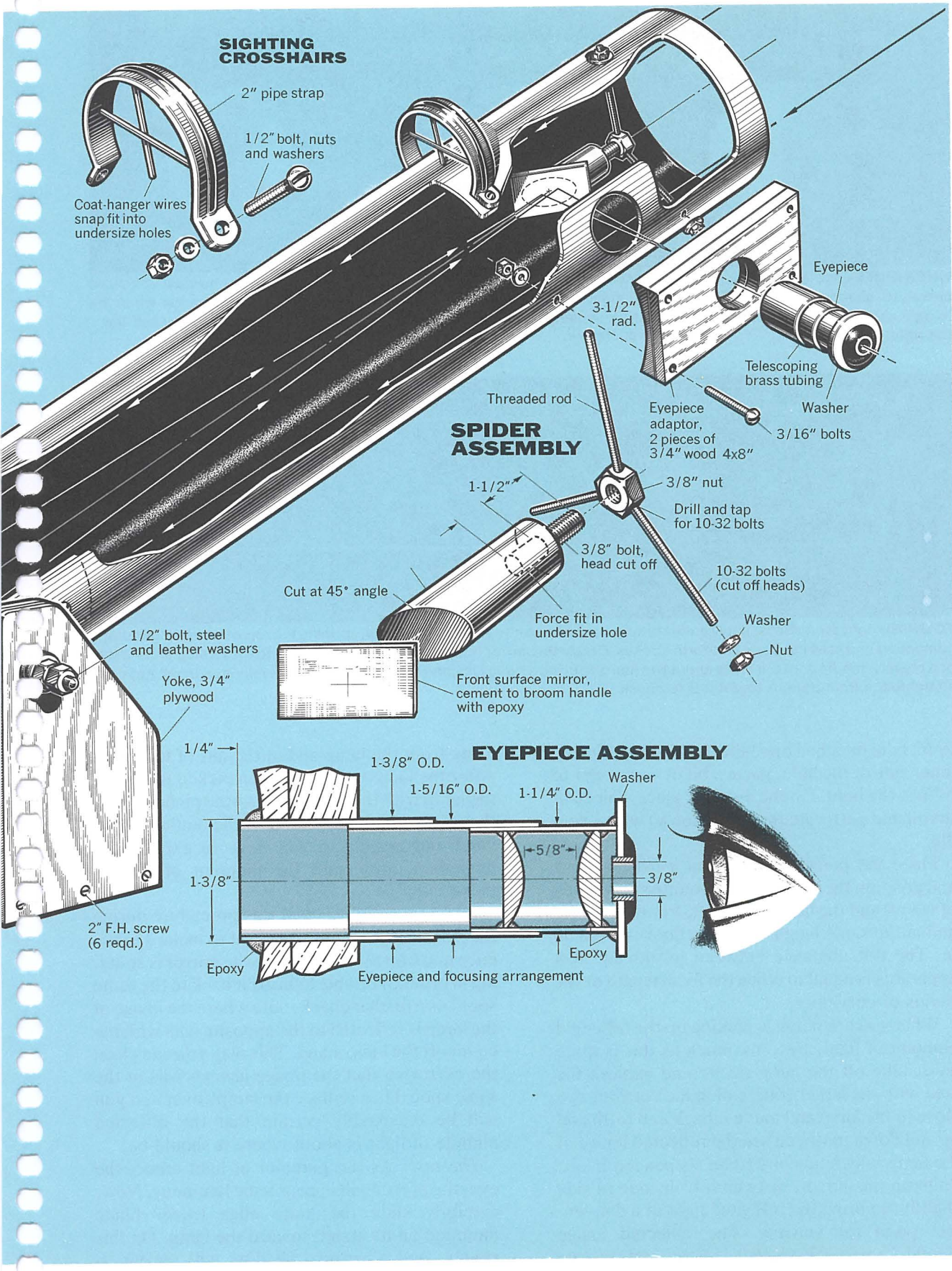
MIRROR CELL ASSEMBLY

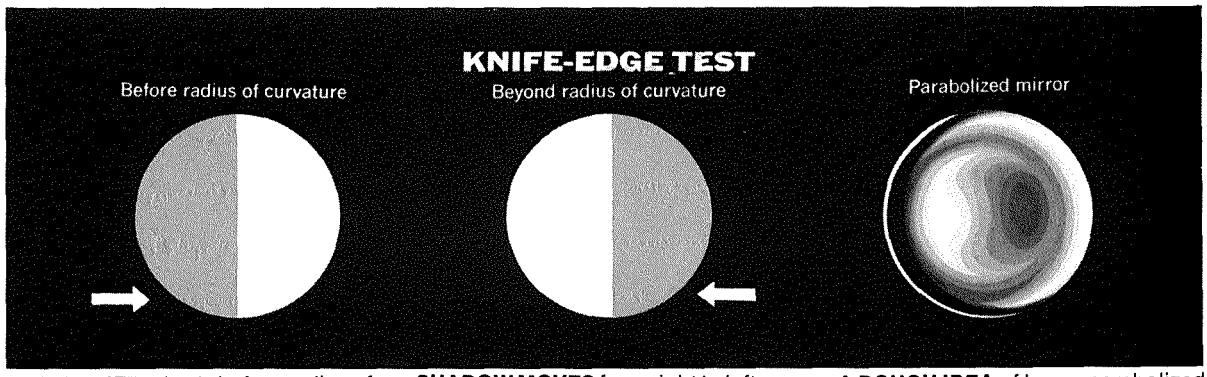
VIEWFINDER



MIRROR CELL consists of two ¾-in. plywood discs, each 6 in. in diameter. Sandwich the discs together and drill holes to pass the ¼-in. bolts. Enlarge the holes in the lower disc for adequate clearance.

Technical Art by Peter Trojan

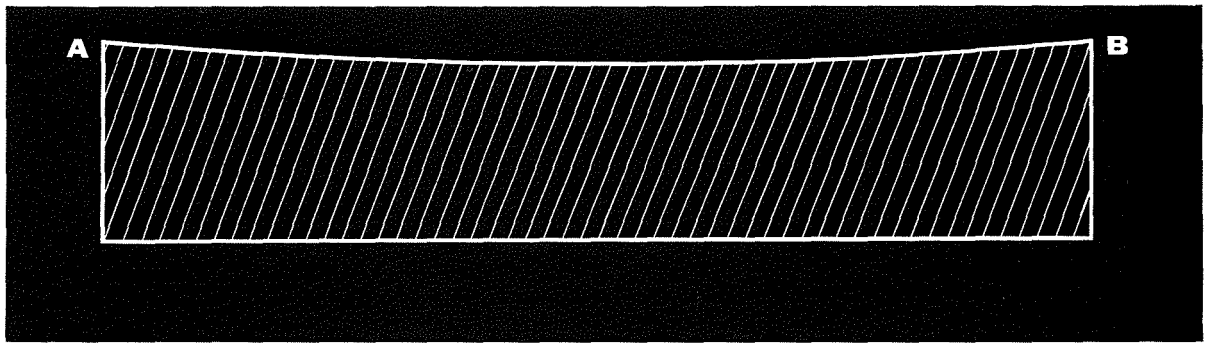

SIGHTING CROSSHAIRS
2" pipe strap
1/2" bolt, nuts and washers
Coat-hanger wires snap fit into undersize holes
Eyepiece
3-1/2" rad.
Telescoping brass tubing
Threaded rod
Eyepiece adaptor, 2 pieces of 3/4" wood 4x8"
Washer
3/16" bolts
SPIDER ASSEMBLY
1-1/2"
3/8" nut
Drill and tap for 10-32 bolts
3/8" bolt, head cut off
10-32 bolts (cut off heads)
Cut at 45° angle
Force fit in undersize hole
Washer
Nut
1/2" bolt, steel and leather washers
Yoke, 3/4" plywood
Front surface mirror, cement to broom handle with epoxy
1/4"
EYEPIECE ASSEMBLY
1-3/8" O.D.
1-5/16" O.D.
1-1/4" O.D.
Washer
5/8"
1-3/8"
3/8"
2" F.H. screw (6 reqd.)
Epoxy
Epoxy
Eyepiece and focusing arrangement



WHEN KNIFE edge is before radius of curvature, shadow moves from left to right as the knife edge is moved to the right.

SHADOW MOVES from right to left as you move the knife toward the lamp if the knife edge is beyond the radius of curvature.

A ROUGH IDEA of how a parabolized mirror shadow will appear when the knife edge is midway between the inner and outer zones.



TO GRIND concave surface, apply an eyedropper-full of water to the top of the tool, sprinkle the top with No. 80 grinding compound and start the back-and-forth strokes. Rotate the mirror ⅛th of a turn every so often and take a step around the barrel every minute or two. It takes about two hours to grind a radius of curvature of 100 in. (plus or minus an inch). Apply a straightedge from point A to point B to check.

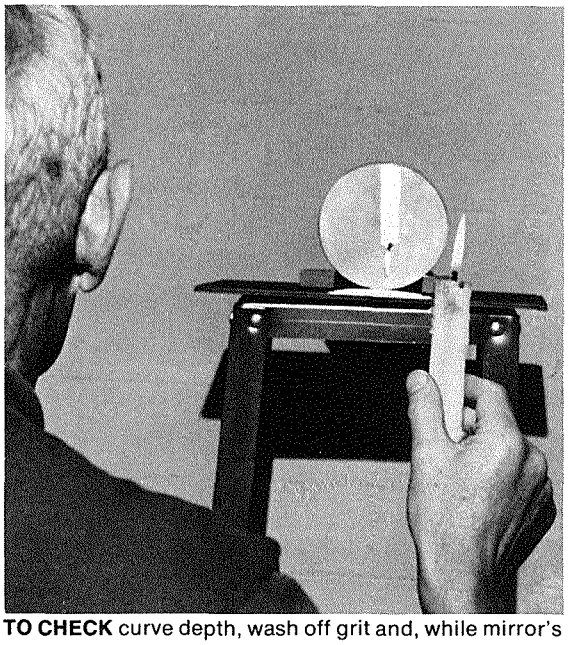
½-in. hole punched opposite the filament. On the inner side of the hole, paste a bit of wax paper to diffuse the light. On the outside, place a piece of tinfoil and perforate the tinfoil (only) with a needle.

Place the polished mirror on a firm support and position the razor blade (mounted on a block of wood) and the lamp about 8 ft. from the mirror and at the same height from the floor—about 30 in. The 8-ft. distance between mirror and test apparatus is equal to twice the focal length or the radius of curvature.

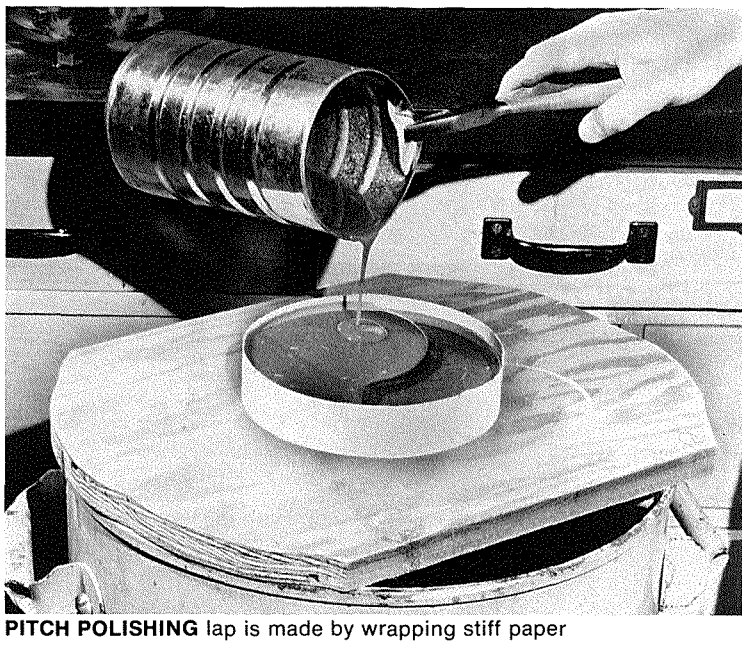
What you are doing is picking up the reflected pinpoint of light. But, inasmuch as this is quite hard, take off the lamp sleeve and explore the area with the larger source of light. Put your eye close to the lamp and move it back and forth and up and down until you see the reflected image of the lamp which appears to be suspended in air. Shim up the mirror, or twist it from side to side slightly, to bring the reflected light to a convenient point for viewing. The reflected image should come back so that it is an inch or two away from the lamp and at the left of the lamp. After the lamp image has been picked up, cover the lamp with the sleeve so that the pinhole faces the mirror. This may disturb the setting somewhat and again you will have to explore the immediate area until the pinpoint of light is picked up.

Since you might repeat this procedure during the stages of polishing, it is best to make a reference mark on the table where the mirror is standing in order to be able to bring it back to the same spot. As a further check, note where the image of the lamp is reflected to the opposite wall with the cover off the lamp stand. This way you can place the mirror so that the image always falls in the same spot. Then replace the lamp cover and you will be reasonably certain that the reflected pinhole of light is about where it should be.

The test. As the pinpoint of light enters the eye, the mirror will appear to be luminous. Now, carefully slide the knife edge (razor blade mounted on its stand) toward the lamp. Do this slowly, and a vertical shadow will appear to



TO CHECK curve depth, wash off grit and, while mirror's wet, hold candle in front. At certain point reflection fills the mirror, then looks upside down.



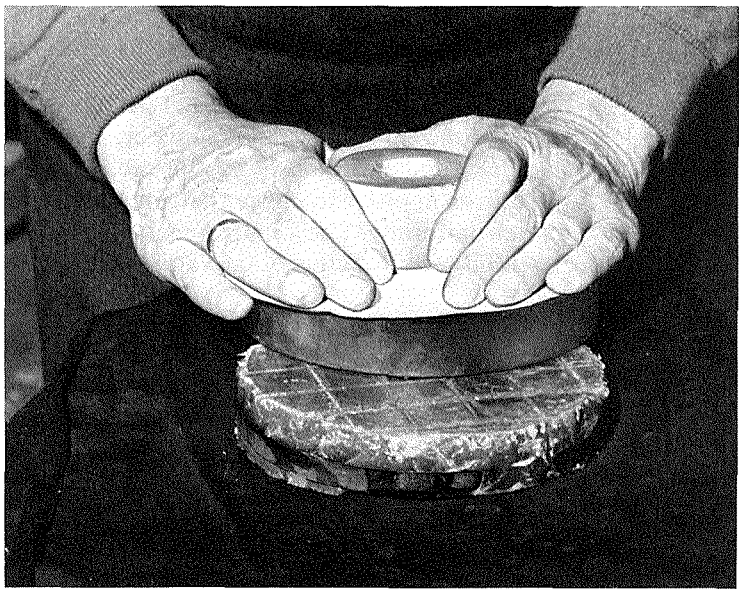
PITCH POLISHING lap is made by wrapping stiff paper around the tool, then pouring heated pitch through several layers of cheesecloth. Finally strip paper.

cross the face of the mirror. This shadow will move from left to right, the same way you are moving the knife edge, *if the knife edge is before the radius of curvature*. If you move the knife edge back an inch or two, the shadow will appear to move right to left when you move the knife edge left to right. When it does so, it is beyond the radius of curvature. Move the knife edge back and forth until at a certain point the mirror darkens evenly all over as the knife edge is moved in toward the lamp. Also, there is no apparent movement of the shadow either way. *This is the shadowgraph of a spherical concave surface.*

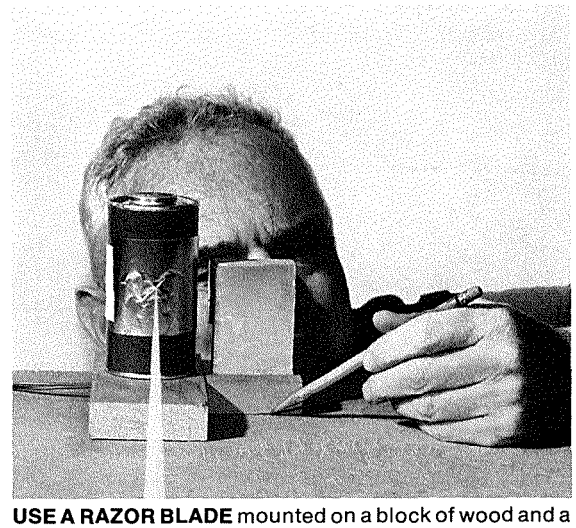
The rays of light going from the pinhole and coming back from the mirror can be considered as a giant radii. It is axiomatic that all parts of a sphere are equally distant from the center. Therefore, half the light rays are cut off at the center; hence the sphere seems to darken evenly

FACETS IN PITCH lap are cut with wet hacksaw blade. Make certain that the two channels do not cross and that no facet is in the exact center of the lap.

POLISHING LAP is made with compound of rouge mixed with water. Long stroke is used only when parabolizing the mirror. This step takes four hours.



HANDLE IS REMOVED by sharp rap with a screwdriver handle as you hold the mirror firmly. Pitch remaining can be cleaned off with razor blade and turps.



USE A RAZOR BLADE mounted on a block of wood and a 25-w. lamp inside a container to test curve of mirror. Pierce tinfoil for a pinpoint light source.

all over. At this point you can use the mirror in your telescope. But if you want perfection, the spherical mirror should be turned into a paraboloid.

To parabolize the sphere the surface must be deepened a few millionths of an inch. To do it, cut two cardboard masks as shown in the drawings. With mask No. 1 determine the exact focal point (half the radius of curvature) of the outer portion of the mirror. Mask No. 2 lets you determine the focal point of the central part of the mirror. For a true paraboloid, you want a difference of $^1/_{10}$th of an inch between each area. To achieve this, increase polishing strokes to about 3 in. Use this stroke for no more than three minutes.

Place mask No. 1 over the mirror and note carefully at just what point the outer portion of the mirror (as seen through the cutouts) darkens evenly. Then use mask No. 2 and do the same thing for the central area of the mirror. You will find that you have to push the knife edge nearer the mirror in order to cause the central area to darken uniformly. Use a sharp pencil to measure the difference in radius of curvature of the two zones.

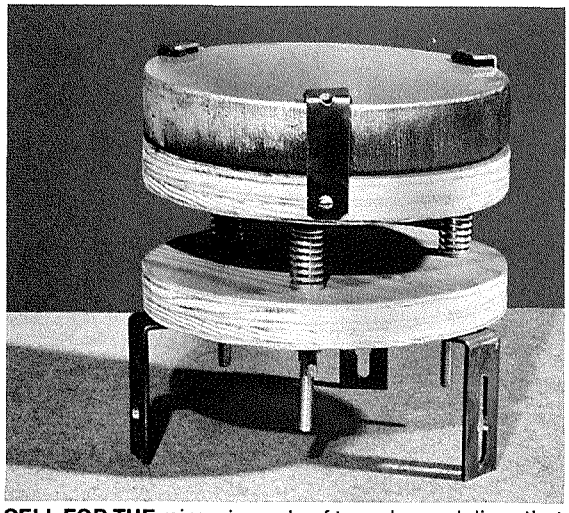
Next, the mirror should be aluminized (commercially) or silvered (which is not as tough as the former). Carefully clean the front surface of the mirror with distilled water and alcohol. Dissolve ¼ oz. of pure silver nitrate in 6 oz. of distilled water and add chemically pure ammonia, drop by drop, until the solution clears. In another vessel pour a teaspoonful of formaldehyde in 2 oz. of water. Add this to the silver solution and immerse the mirror in it until a good coat is formed. Stand the mirror up to dry.

With the mirror completed, the next step is to make the tube which will hold the optical components. It can be of cardboard, galvanized sheet metal or aluminum.

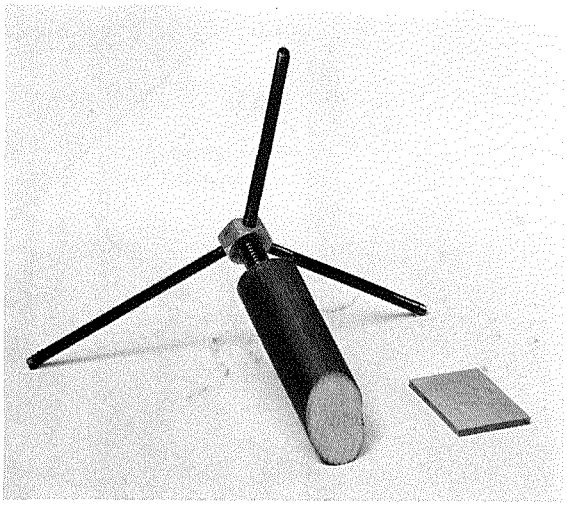
The cell. This holds the mirror in the bottom of the tube. Cut the two discs and drill three holes through both. The holes should be 120° apart and about 1 in. from the edge. In order to pass ¼-in. bolts freely, one set of holes should be ¼ in. dia. (countersunk) while the holes in the second disc should be ⅜ in. dia. Then pass the three bolts through the disc with the smaller holes and lock them on the other side by means of washers and nuts. Three springs (auto valve springs cut down to about 2 in. are fine) are placed over the protruding bolts and then the second disc is mounted on the bolts.

The mirror is fastened to the cell by means of three brass clips screwed to the side of the upper disc at 120° intervals. The clips should have ¼-in. flanges at the ends and the flanges should be felt-padded to avoid scratching the mirror. The washers and thumbnuts complete the mirror cell assembly.

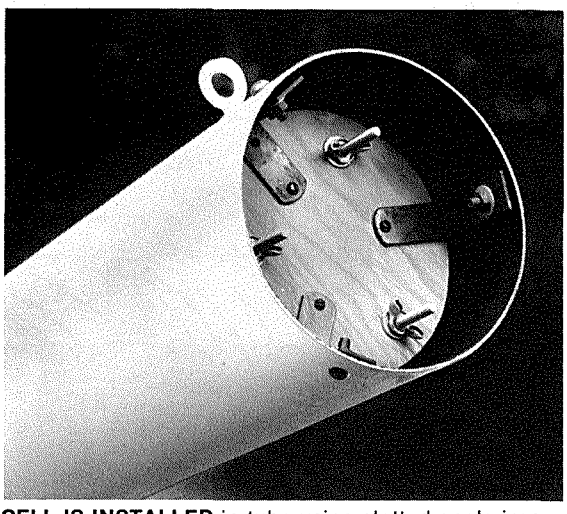
When the cell is mounted in the bottom of the tube, you will be able to tilt the mirror in various directions by loosening and tightening the thumbnuts. Three angle irons screwed to the bottom of the mirror cell, and in turn fastened to the inside of the tube, hold the mirror and cell assembly securely in place. By cutting slots in one leg of each angle iron, you'll be able to move the entire cell up or down to compensate for any



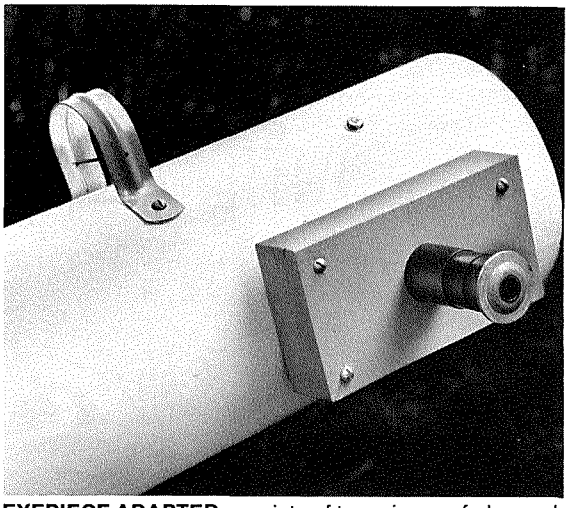
CELL FOR THE mirror is made of two plywood discs that are separated by three springs. The mirror is fastened to the top disc by means of three clips.



SPIDER for diagonal consists of broom handle cut at 45° miter, a ⅜-in. bolt with head cut off and three lengths of threaded rod into ⅜-in. tapped nut.



CELL IS INSTALLED in tube using slotted angle irons which permit considerable adjustment to allow for possible errors when the parts are positioned.



EYEPIECE ADAPTER consists of two pieces of plywood glued together with a 1⅜-in. hole at the center to accept telescoping tubing and eyepiece.

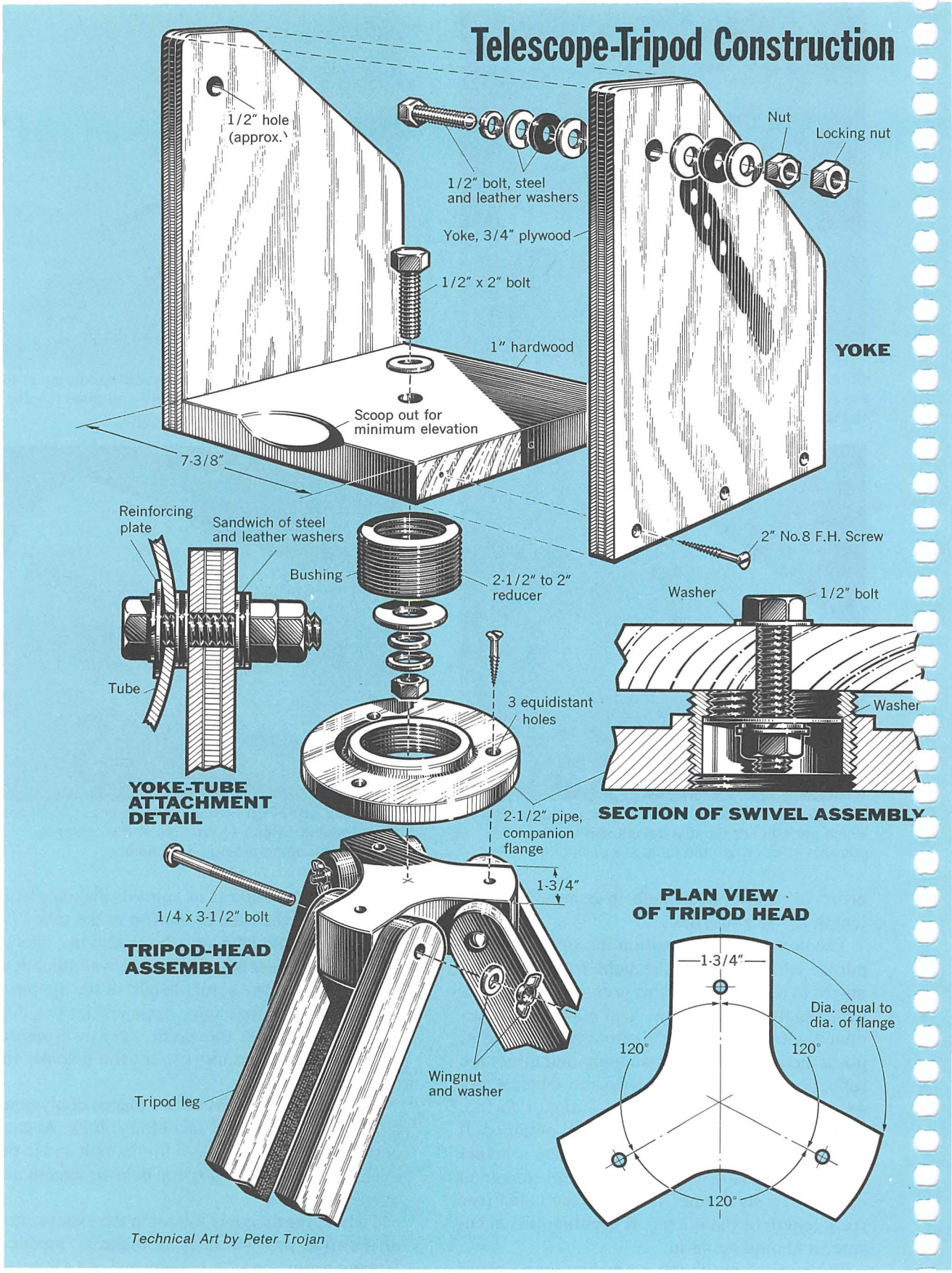
error you may have made in computing focal length of your mirror.

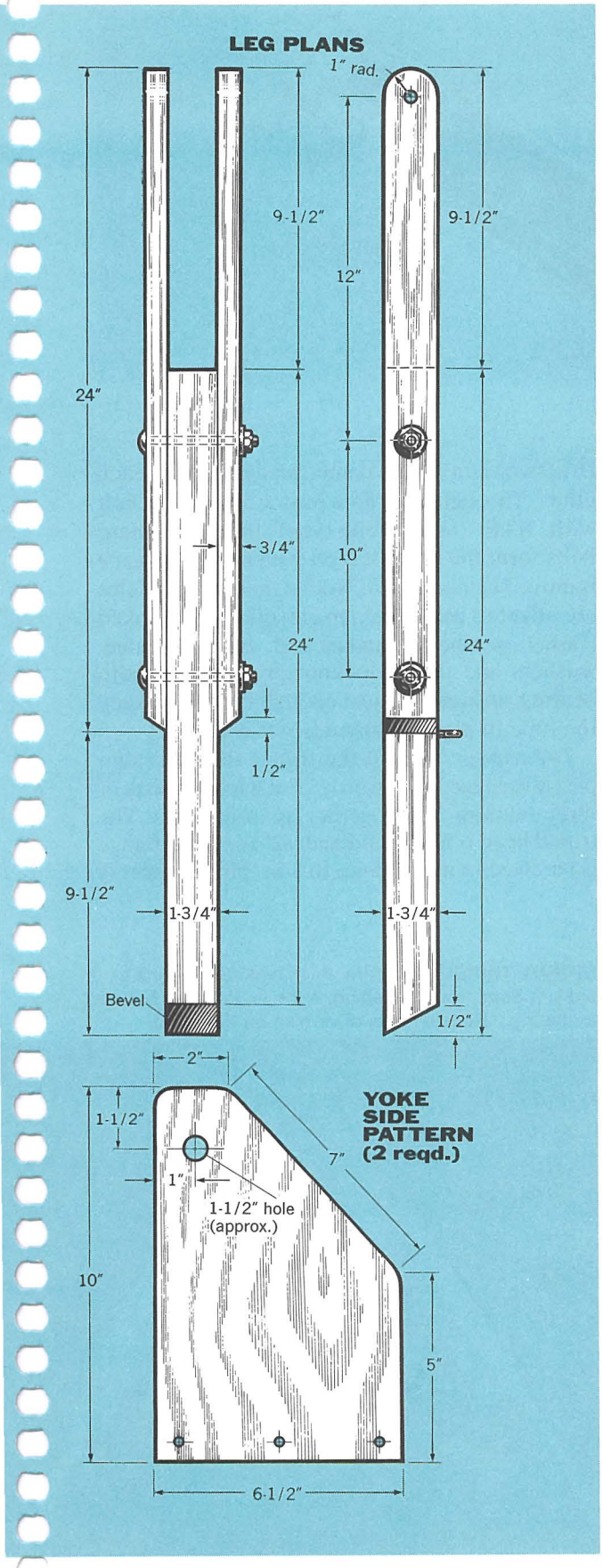
The next step is to position the small diagonal mirror which reflects the light from the main mirror to the eyepiece. This is determined by the focal length of the mirror. You must now determine the true focal length within ¼ in. To do it, place the mirror in bright sunlight and direct the reflection of the sun to a business card held about 48 in. away. Move the card nearer or farther away until a sharp image of the sun is obtained. It will be about ½ in. in diameter. Have a helper carefully measure the distance from mirror to card with a steel tape. This distance is the true focal length of the mirror. If grinding was accurate, it should be 48 in.

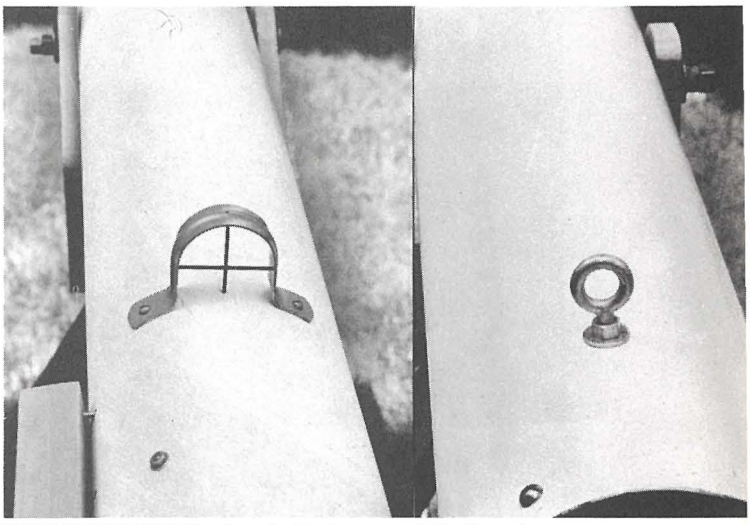
From this distance (48 in.) deduct the height of the eyepiece adapter (2 in.) plus its distance from the center of the tube to the top of the tube (3½ in.). This should give you about 42½ in., plus or minus ½ in., depending upon the wall thickness of the tube and the actual height of the eyepiece adapter. The slotted angle irons will let you correct any errors. At this point, 42½ in. from the front surface of the mirror, cut the hole for the eyepiece adapter.

The adapter consists of two pieces of plywood glued together to make an oblong block. At each corner drill a hole to pass a $^{3}/_{16}$-in. bolt and in the exact center, drill a 1⅜ in. hole to accept the eyepiece tubing.

To hold the diagonal mirror in the exact center of the tube you will have to make a "spider." Using a broom handle, cut one end at a 45° miter,


Telescope-Tripod Construction
1/2" hole (approx.)
1/2" bolt, steel and leather washers
Nut
Locking nut
Yoke, 3/4" plywood
1/2" x 2" bolt
1" hardwood
YOKE
Scoop out for minimum elevation
7-3/8"
2" No.8 F.H. Screw
Reinforcing plate
Sandwich of steel and leather washers
Bushing
2-1/2" to 2" reducer
Tube
YOKE-TUBE ATTACHMENT DETAIL
3 equidistant holes
Washer
1/2" bolt
Washer
SECTION OF SWIVEL ASSEMBLY
2-1/2" pipe, companion flange
1-3/4"
1/4 x 3-1/2" bolt
TRIPOD-HEAD ASSEMBLY
PLAN VIEW OF TRIPOD HEAD
1-3/4"
Dia. equal to dia. of flange
120°
120°
120°
Wingnut and washer
Tripod leg
Technical Art by Peter Trojan



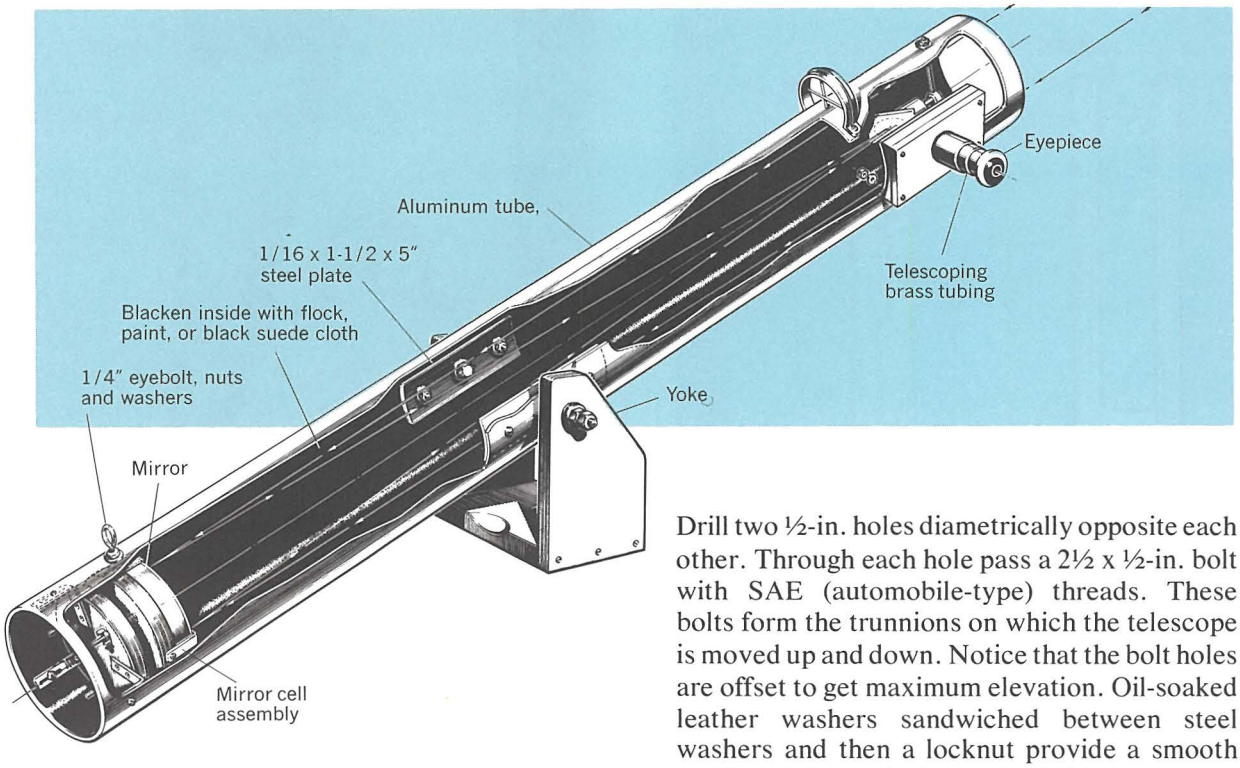


FINDER CONSISTS of eyebolt at one end (left) and coathanger wire fitted into holes drilled in pipe strap and tube at the other end. Paint these black.

the other end absolutely square. Next get a ⅜-in. bolt, drill a slightly undersize hole in the square end of the broom handle and screw the bolt into the handle about an inch. Cut off the head, leaving 1½ in. projecting from the end of the handle. Next get a nut to fit the bolt and drill and tap for a 10x32 thread in three alternate sides of the nut. In addition you will need three 10x32 bolts, each 3½ in. long. Cut off the heads. Glue the diagonal mirror to the mitered end of the broom handle with epoxy cement. *The diagonal is a front-surface mirror, so make certain you apply the epoxy to the back of the mirror.*

The diagonal is positioned directly opposite the eyepiece adapter. Measure the distance from the midpoint of the diagonal to the three 10x32 bolts and drill three holes, each spaced 120° apart, in the tube to accept the spider. Provision for adjusting the diagonal so that it is opposite the eyepiece adapter is possible by screwing the broom handle up or down into the nut held by the spider. A locknut is not necessary as the three spider legs bear against the ⅜-in. bolt.

With the two plano-convex lenses (included in the kit) and three lengths of telescoping brass tubing, you can make a very fine 1-in. focal length Ramsden-type eyepiece with a focusing arrangement that will allow you to focus as close as 100 ft. How to mount and space the lenses is shown in the art. The largest length of brass tubing (1⅜ in. o.d.) should be inserted into the hole previously drilled in the eyepiece adapter. Have it project about ¼ in. and run a bead of cement around the protruding end so as to anchor it in place.

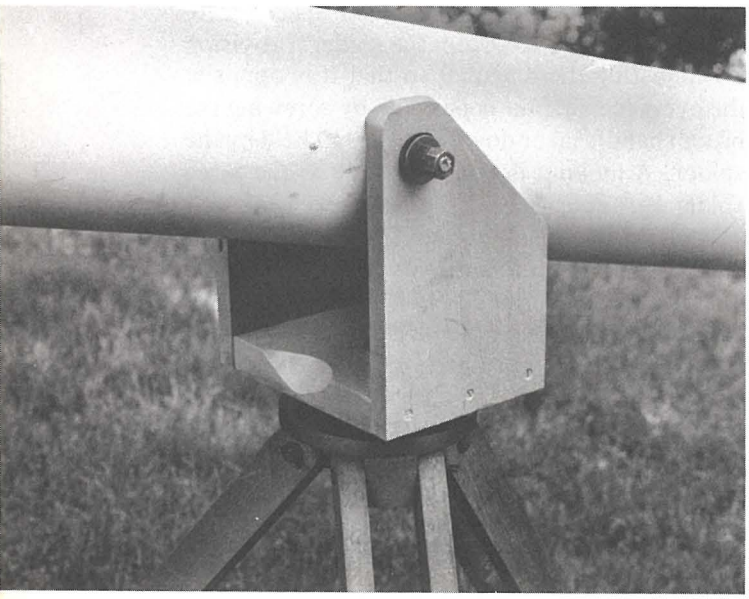


Finally, paint or spray the inside of the telescope tube flat black to kill reflections.

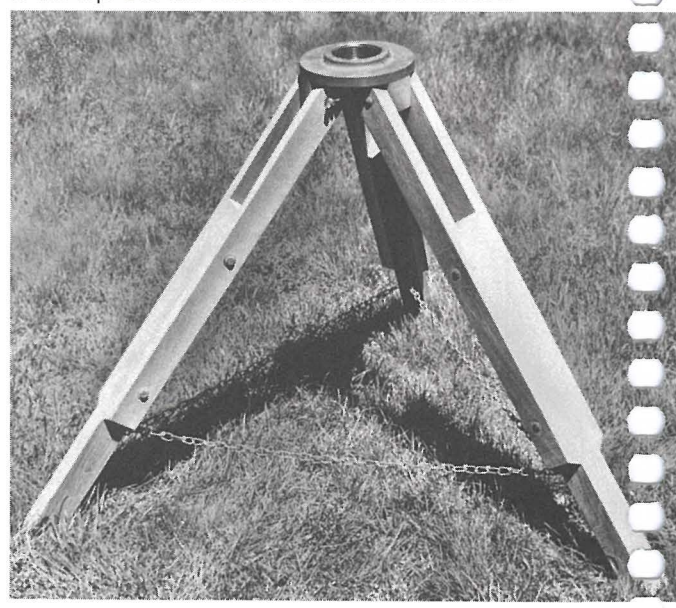
The yoke. The next step is to suspend the completed telescope in its yoke and get the point of balance by resting the tube on a round pencil. Mark the balancing point and remove all parts. Drill two ½-in. holes diametrically opposite each other. Through each hole pass a 2½ x ½-in. bolt with SAE (automobile-type) threads. These bolts form the trunnions on which the telescope is moved up and down. Notice that the bolt holes are offset to get maximum elevation. Oil-soaked leather washers sandwiched between steel washers and then a locknut provide a smooth bearing surface with just enough friction to keep the tube in place at any desired angle.

The tripod. Though the tripod shown is simple, it is rugged and sturdy. Each leg consists of three sections held together by ¼-in. bolts. The tripod head is hardwood and a 2½-in. pipe flange is screwed to it. A 2½-in. to 2-in. pipe reducer is

YOKE IS MADE by fastening two pieces of ¾-in. plywood to hardwood base. Notice that holes for bolts are offset to provide maximum elevation.



STURDY TRIPOD has 1¾-in.-thick legs plus chains to prevent them from spreading. A 2½ in. flange is bolted to the top. Use two coats of varnish on the wood.



fastened to the bottom of the yoke with bolt and washer. Because American pipe threads are tapered, it is a good idea to lap the pipe reducer to the pipe flange. Apply some of the leftover grinding compound and water to the threads of the reducer. Screw in the reducer as far as you can by hand and keep working it back and forth; a half-turn or so is enough. Keep this up for 15 minutes and you will have a smooth fit between flange and reducer after you have washed out all of the grit and applied a little grease to the threads.

The sighting aid. Unless you have some sort of finder it is impossible to know what you are looking at in the heavens. The finder on this 'scope is a ¼-in. eyebolt bolted to the other end (aligned, of course). Cross hairs are a couple of wires passing through holes drilled in the pipe hanger.

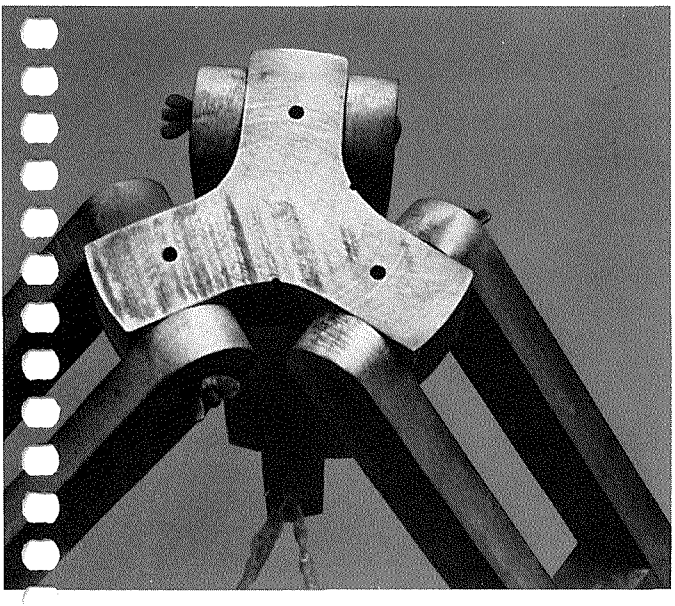
Optical alignment. Point the tube, with all components in place, at the sky or a brightly illuminated wall. As you look through the adapter you'll see the diagonal mirror. Then, reflected in the diagonal mirror, you'll see the walls of the tube and at the bottom a white disc—the mirror itself. More or less in the middle of the mirror you will see a secondary and smaller image of the diagonal suspended by its three supports. *All of these images should be concentric.*

If the diagonal is not in the exact center of the tube it can be made so by loosening the nuts that hold the spider to the tube and adjusting each leg of the spider. And the main mirror should be adjusted so the image of the diagonal is in its exact center. To do this best, have a helper turn the thumbnuts at the back of the mirror cell, one or two at a time, while you observe results by peering through the adapter. A good method is to number each thumb nut, and tell your assistant which you want turned.

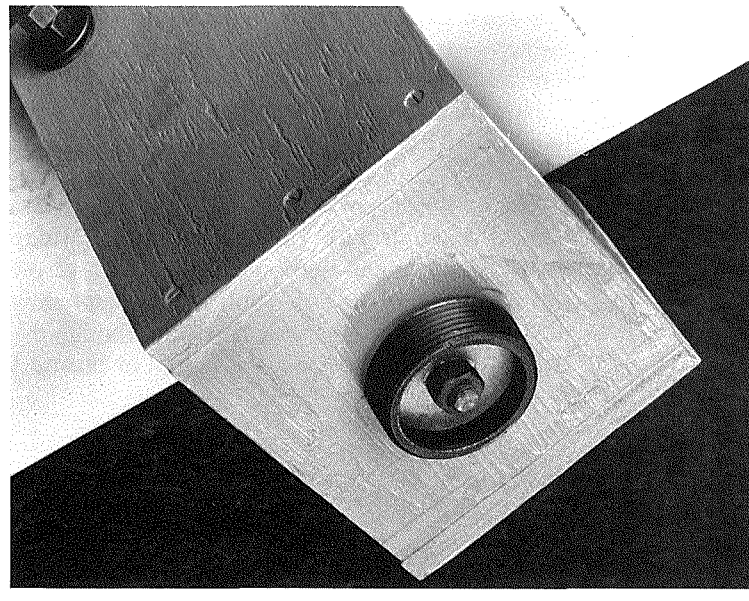
Astronomical eyepieces are made in standard 1¼ in. o.d. Focusing is done by sliding the eyepiece in and out of the adapter with a twisting motion. The power of our telescope is determined by the focal length of the eyepiece used. The eyepiece we made has a focal length of 1 in. and will give 50-power. With a ½-in. eyepiece you'll get 100-power; with a ¼-in. eyepiece, 200-power. Dividing the focal length of the eyepiece (for example ½-in.) into the focal length of the mirror (50 in.) will determine the power of a telescope.

Your first look. The object most often chosen is the moon. For best viewing, wait until it is at first quarter or last quarter; a look at a full moon will be disappointing. Locate the moon in the approximate field of view with the peep-sight finder, then go to the eyepiece. At first you'll see a giant glob of light. Adjust the eyepiece until this becomes the rills and valleys, mountains and craters of our nearest neighbor in space. From here on you'll be hooked on star-gazing.

TO KEEP tripod legs from spreading and collapsing, use three lengths of inexpensive sash-chain and three eyehooks fastened to the legs at the bottom.



PIPE REDUCER (2½ to 2 in.) is bolted to yoke bottom. For smooth action, lap threads of reducer and flange with grinding compound, then apply oil or grease.



Turn your camera lens into a telescope

By WALTER GOTTLIEB

You can convert your powerful photographic lenses for use as a telescope without damaging their function as camera lenses. All you do is combine them with a small eyepiece lens

PHOTOGRAPHERS use nonphotographic gadgets all the time. But you can also use your photo gear for nonphotographic purposes. Your camera's interchangeable lenses, for example, can be turned into compact, highly corrected telescopes at hardly any cost, with no more labor than drilling two holes—and no impairment of their photographic usefulness.

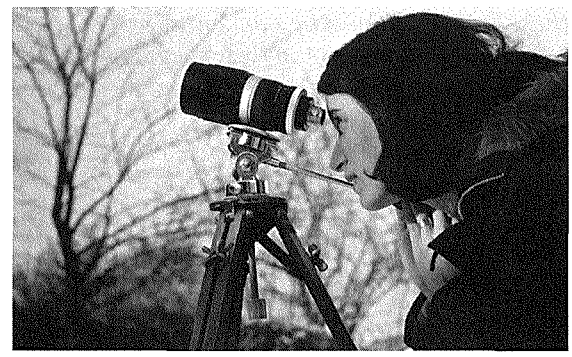
A telescope is merely a comparatively long focal length lens (the objective) that aims at the object to be viewed and a shorter focal length lens (the eyepiece) that magnifies the image formed by the objective lens and presents it to the viewer's eye. The longer the focal length of the objective and the shorter that of the eyepiece, the greater the magnification of the telescope. So if you couple a short-focus lens from your movie camera to a telephoto from a 35-mm or larger camera, you can assemble a telescope that's powerful indeed. (The actual power of the telescope can be found by dividing the objective's focal length by the eyepiece's.)

If you don't shoot movies or if your movie camera, like most current models, does not have a removable lens, you can pick up a lens for your eyepiece dirt-cheap at a used camera counter. The least expensive way is to buy an obsolete, inoperative regular-eight camera, unscrew the lens and throw the camera away.

Now drill a well-centered hole in the larger lens's rear cap, just wide enough to clear the movie lens's threads (⅝ inch for lenses from 8-mm cameras, one inch for 16-mm-camera lenses). Then drill out the movie lens's rear cap as wide as you can without damaging its screw threads, or grind the cap's bottom off just below the threads. (This cap must be metal, though the larger lens's cap can be either metal or plastic.)

Centering the hole in the larger lens cap is important for good optical performance. One way to center it precisely is to coat the cap with white tempera paint, then scribe a series of straight lines in the paint with a marking gauge set at approximately the lens cap's radius, turning the cap slightly for each line. The intersections of the scribed lines will form a polygon small enough for you to judge its center with as much accuracy as you need to center-punch the hole before drilling it.

To assemble, insert the threaded end of the movie lens into the hole in the larger lens cap and fasten it in place by screwing on the drilled-out movie lens cap. Screw the telephoto cap onto the back of its lens, and there it is—a high-power



A LITTLE WORK and an old movie camera lens made this powerful telescope from a telephoto lens.

INTERCHANGEABLE movie lens, mounted through a hole in telephoto's rear lens cap, serves as eyepiece.

SEE ALSO

Lenses, photo . . . Photography . . . Photo hints . . . Telephotos

telescope! If you can't bring a distant object into focus using the telephoto's focusing ring, insert one or two extension tubes between the lenses to bring the eyepiece to the proper focal point. You can estimate the amount of extension necessary by looking through the two lenses, both hand-held, and varying the separation between them until a distant object looks sharp.

With a 300-mm telephoto and the 5.5-mm wide angle from my 8-mm camera, I get over 50-power magnification. For less power and wider viewing angle I use the 12.5-mm normal lens or the 25-mm movie tele as eyepiece. If you have a telephoto lens converter, its use will increase the power of the 'scope by its usual conversion factor. Naturally no matter how many lenses you use in your combinations, you need make only one coupler.

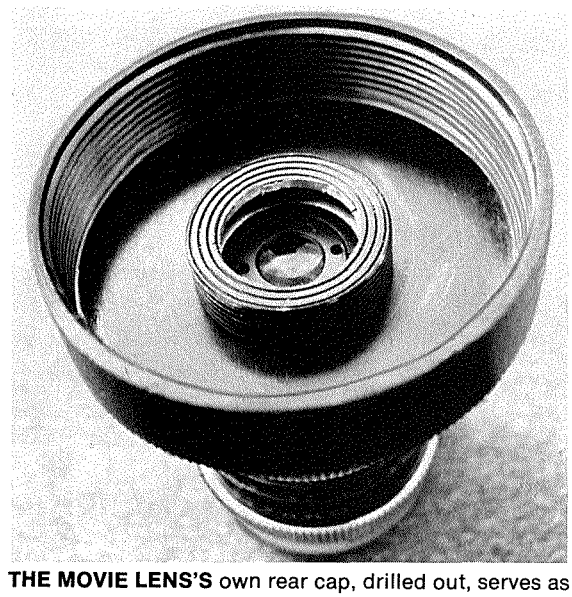
While these telescope combinations are powerful, they have a disadvantage common to all celestial telescopes: The view is reversed, upside-down and backwards. For looking at things down here on earth, you'll find it convenient to have a negative-focus eyepiece (one that makes things look smaller to the eye) that keeps things right-side up. For this I use the negative front element of an inexpensive lens salvaged from an old 8-mm camera (practically all normal focal length lenses use a negative first element). Unscrewing and discarding the rear element, I mounted the remainder of the lens in the eyepiece coupler as before. This eyepiece needs less extension behind the objective lens than the other eyepieces; it may even have to be mounted on the *inside* of the telephoto's cap to obtain the proper focus.

mounting your telescope

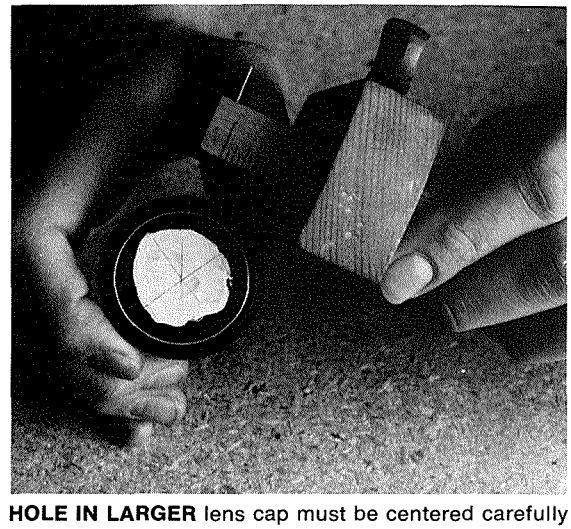
In use, mount your telescope on your tripod by means of the socket built into your long lenses for clearer, less tiring viewing. Telephotos without built-in tripod sockets will usually yield low enough magnification so that they can be used hand-held.

The telephoto lens cap which has been converted into the eyepiece coupler can still be used for lens protection when not being used in telescopes by plugging the hole with a movie camera body cap or turret plug, held in place by the drilled-out movie lens cap.

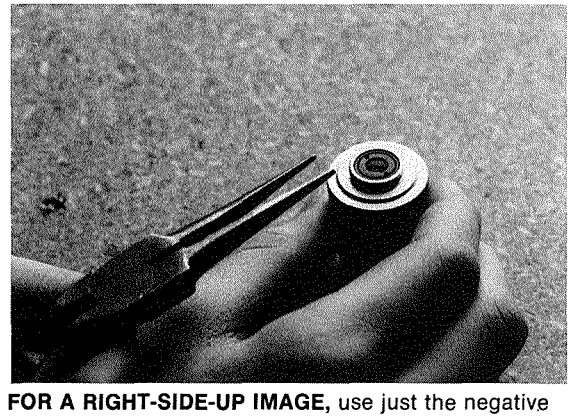
Now, just by reaching into your gadget bag for a combination of lenses that you're not using on your cameras at the moment, you're ready for a close-up look at anything on land, sea, sky or beach.



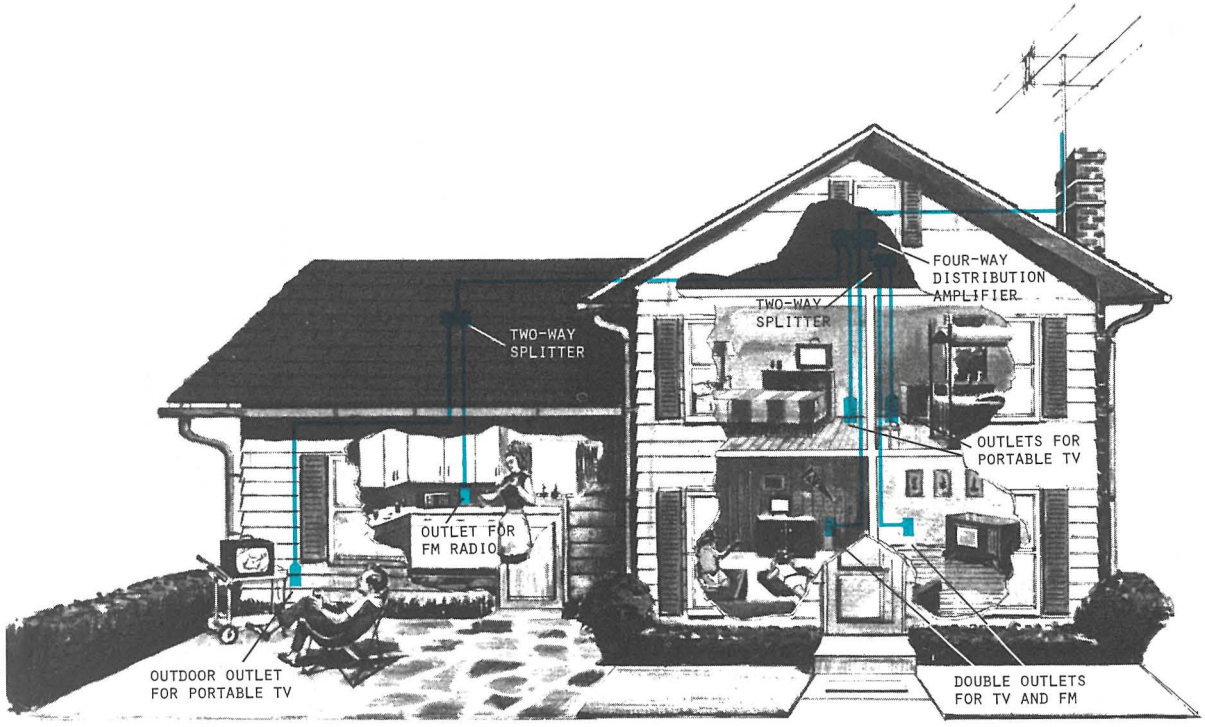
THE MOVIE LENS'S own rear cap, drilled out, serves as its retaining ring (see text).



HOLE IN LARGER lens cap must be centered carefully and be wide enough to clear movie lens's threads.



FOR A RIGHT-SIDE-UP IMAGE, use just the negative front element from a junked 8-mm camera's lens. Unscrew the rear element using a needlenose pliers as a spanner, then discard the unneeded element.



How to have TV in every room in the house

By FOREST H. BELT

A master antenna system will let you operate two or more sets simultaneously in different locations and give you extra outlets anywhere you want them. Here's how to work out a plan to suit you and your home

■ YOU PROBABLY OWN more than one TV set or soon will. Many families have a console and one or more portables. The portable gets lugged around from room to room. Also, the purchase of a color set frequently means there's a black-and-white available for use as a second set.

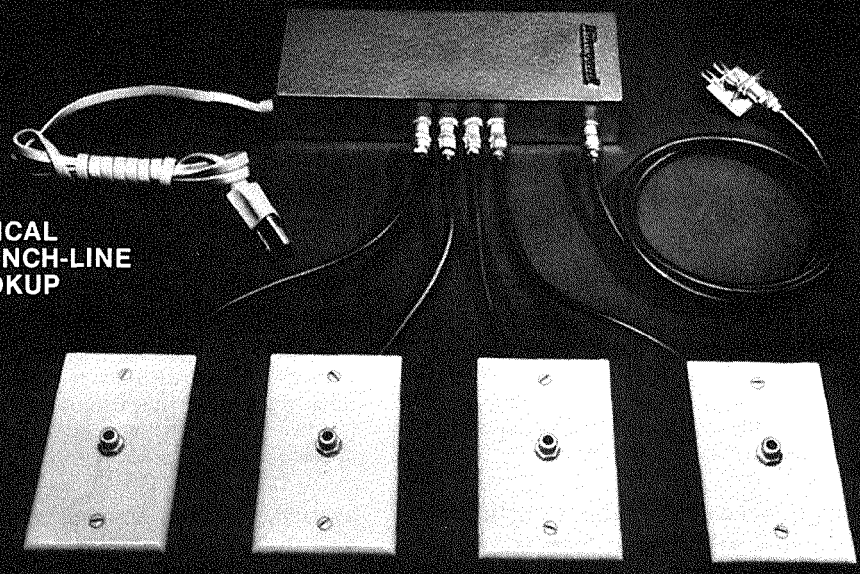
If you're operating these extra sets without a rooftop antenna, chances are you're not getting as good reception as you could. You don't have to install a separate antenna for each set, though. The answer is MATV—Master Antenna Television. This is a system that lets you connect two, four, eight or even more TV sets to a single antenna without any loss of signal or interference between the sets.

Apartment buildings use MATV systems to feed antenna signals to hundreds of sets. You can install a miniature version in your own home. You need only a few pieces of equipment and some connecting cable. Not only will such a system feed several sets simultaneously, but it will let you watch TV anywhere you want. You can have an antenna outlet in every room—even outdoors. Connecting a TV is as simple as plugging a lamp into a wall socket. You can enjoy the luxury of watching the Late Show in bed or a ball game out on the patio while relaxing in the sun. When a youngster wants to see something, he can pack a portable off to his own room and leave you undisturbed.

Because FM frequencies fall within the TV range, they can be picked off the same antenna.

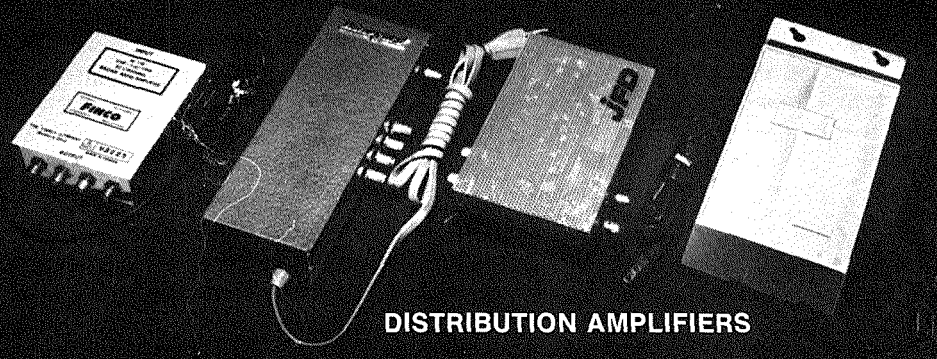
SEE ALSO
Antennas . . . Electrical wiring . . . Electronics . . . Hi-fi centers . . . Masts . . . Shortwave radio . . . Stereo . . . Television turntables . . . Transistors

WHAT YOU NEED FOR A MASTER ANTENNA SYSTEM



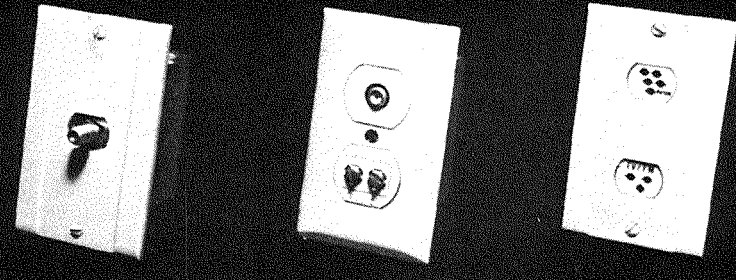
TYPICAL BRANCH-LINE HOOKUP

YOU CAN FEED FOUR TV SETS simultaneously from a single antenna with a setup like this. The amplifier at top connects to the antenna and has four outlet terminals for running branch lines to wall outlets in four different locations. Fifth terminal at right is for the input line from the antenna



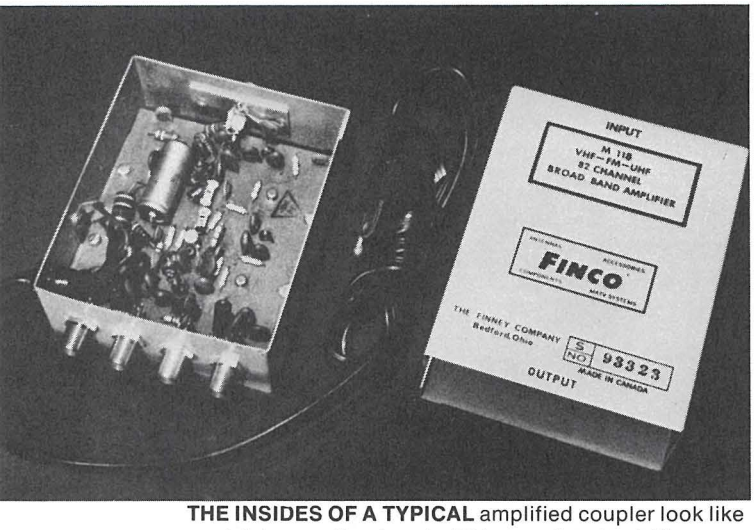
DISTRIBUTION AMPLIFIERS

BASICALLY SIMILAR, distribution amplifiers are available in a variety of makes and models. Those here are all four-way types designed to feed four TV outlets. Makers are, from left to right, Finco, Winegard, JFD and Jerrold. Amplifiers are powered by house current, need a nearby outlet to plug into

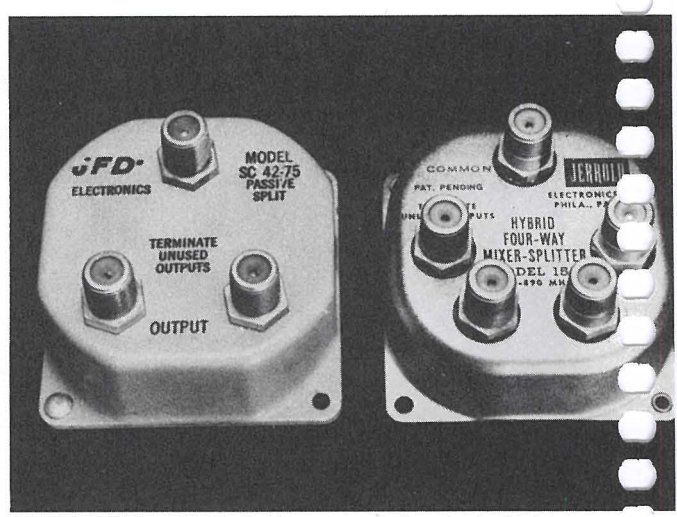


TV AND FM WALL OUTLETS

DESIGNED TO FIT standard electrical wall boxes, antenna outlets come in several styles to suit different needs. One at left provides single 75-ohm tap for a TV set. Combination outlet at center has a 75-ohm tap for TV and 300-ohm terminals for an FM radio. At right is a dual outlet with one tap for either FM radio or TV and a multi-conductor receptacle for plugging in an antenna rotor control



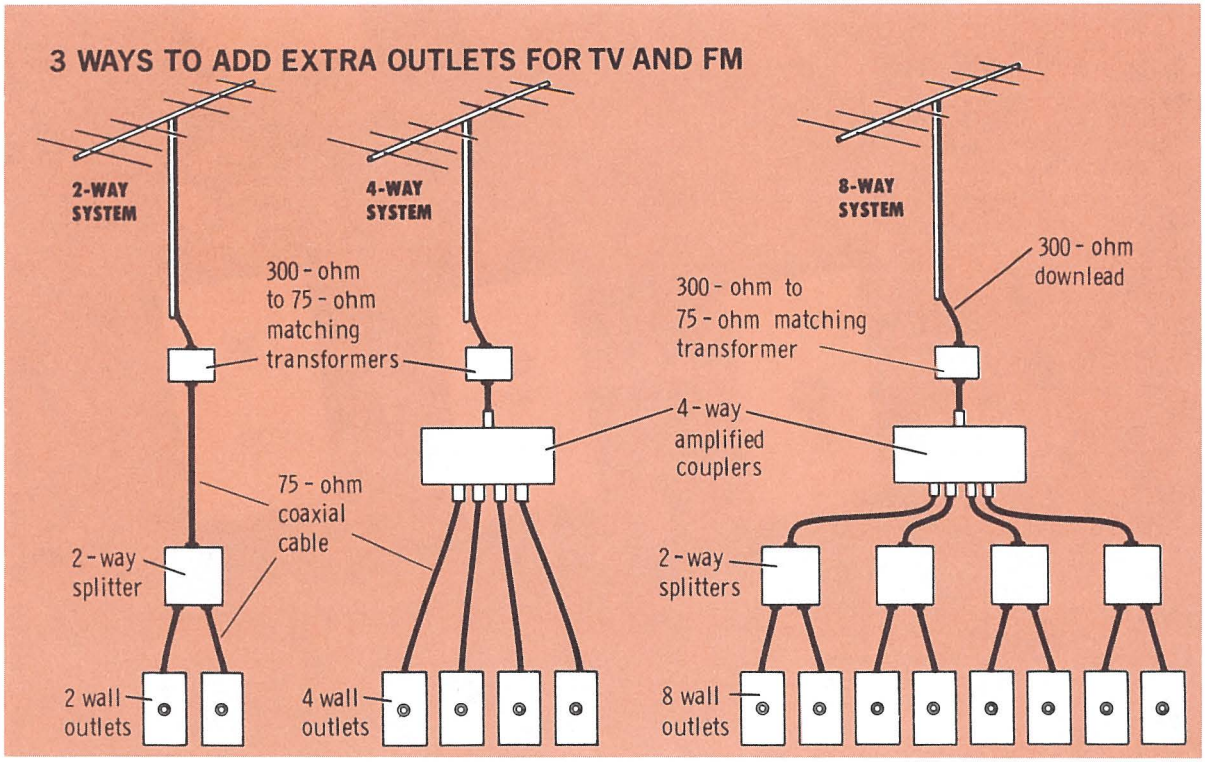
THE INSIDES OF A TYPICAL amplified coupler look like a miniature radio chassis. This transistorized Finco model has one input at the top for the antenna lead and four outputs at the bottom for branch lines.

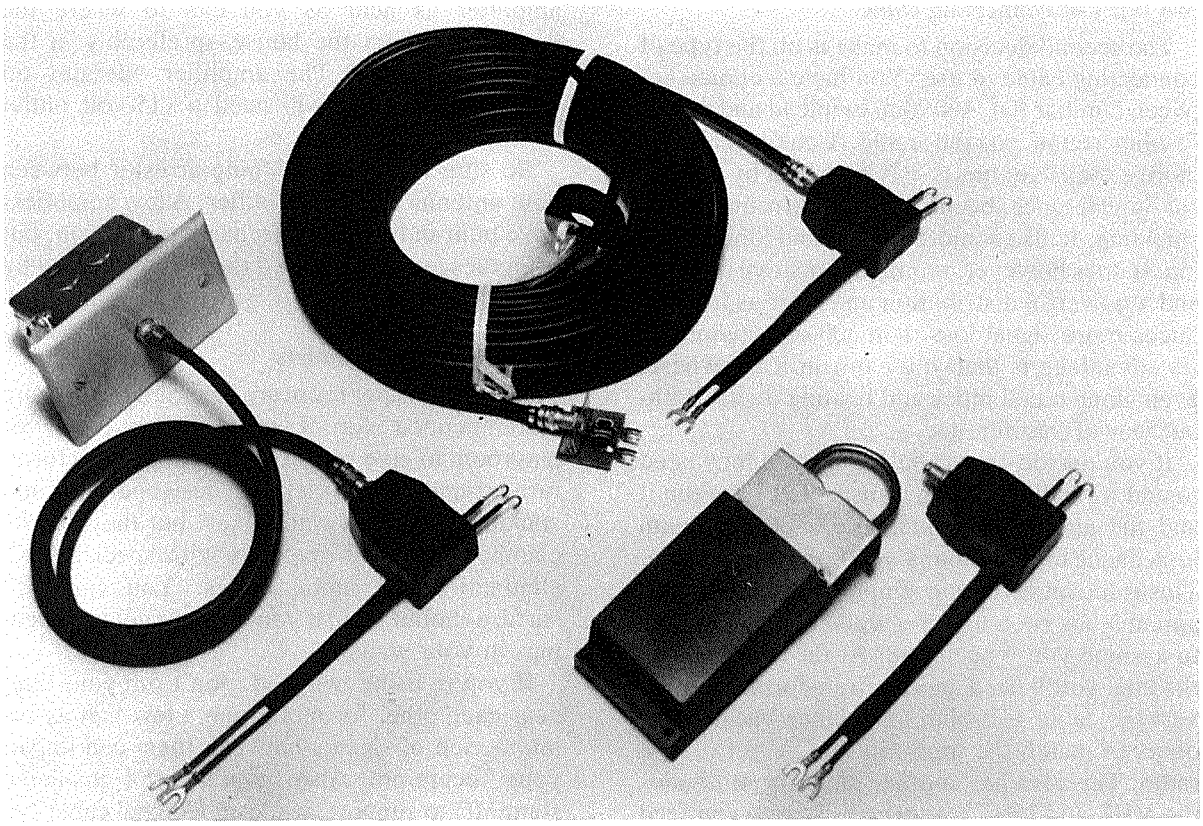


PASSIVE SPLITTERS divide antenna signals, but add no amplification. They can be combined with amplifiers to add more branch lines. Left to right above are two-way JFD model and four-way Jerrold.

A MATV system makes it possible to split the FM and TV signals so you can feed them to different sets. FM reception is often improved, especially on stereo, because the signal, in addition to being split off, is given a boost in power. Color TV, which also needs a powerful signal, frequently benefits in the same way from the installation of a MATV system.

Most TV-antenna manufacturers and electronic-supply houses sell the parts for a MATV system. You can have all sorts of hookups. The first thing to decide is how many outlets you're going to need. If you just want to connect two TV sets to one antenna, you can buy what is called a passive splitter. This connects to your antenna's downlead and provides two outlets for running branch lines to two receivers. It's called "passive" because it merely isolates the receivers; it doesn't boost or amplify the TV signal. In fact, it introduces a slight loss as it divides the signal.


3 WAYS TO ADD EXTRA OUTLETS FOR TV AND FM
2-WAY SYSTEM
4-WAY SYSTEM
8-WAY SYSTEM
300 - ohm to 75 - ohm matching transformers
300 - ohm to 75 - ohm matching transformer
300 - ohm downlead
4 - way amplified couplers
75 - ohm coaxial cable
2 - way splitter
2 - way splitters
2 wall outlets
4 wall outlets
8 wall outlets



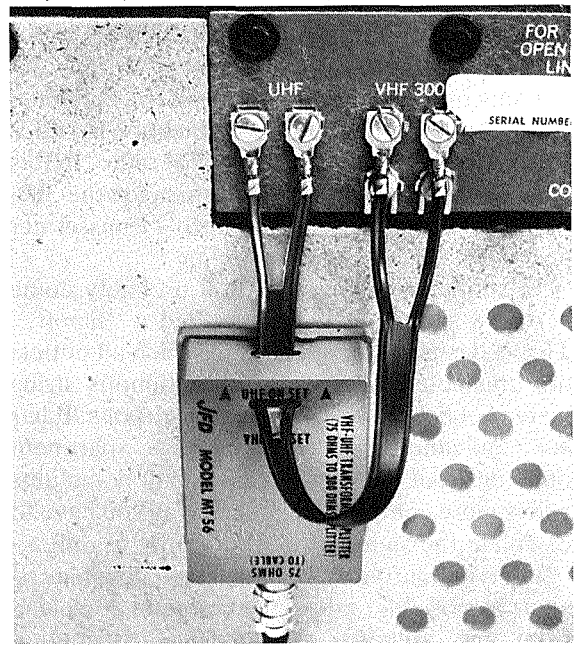
HANDY ACCESSORIES for installing a master antenna system are shown above. At left is a short 75-ohm coaxial cable for hooking a TV set to a wall outlet. It comes with connectors attached and a matching transformer. At center is a 100-foot roll of coaxial cable with an antenna-matching transformer on one end and a set-matching transformer on the other. At the right is a separate kit of matching transformers without cable. All accessories shown here are manufactured by Winegard.

A passive splitter is all right if you have a sensitive antenna or live in a strong signal area where the loss won't be noticed. If your signal is questionable or you want a whole string of outlets throughout the house, you're better off with an amplified coupler, also known as a distribution amplifier. This contains a miniature electronic amplifier that gives the signal a boost to overcome the loss of splitting. In some cases, the signal reaching the set is actually stronger than when it arrived at the antenna.

Distribution amplifiers come in different models depending on the number of outlets you want. One of the most common types for home use is a four-way coupler that gives you connections for four branch lines. If you need more outlets, you can install a splitter in each branch line, dividing it in two and giving you a total of eight lines. Or you can connect additional amplifiers to the first amplifier, providing even more capacity.

Splitters and amplifiers can be combined in almost endless arrangements to give you the number of outlets you want.

MATCHING TRANSFORMERS like this JFD model mount on the back of the TV and convert 75-ohm antenna-line impedance to 300 ohms for the receiver. They also split VHF and UHF signals.



two types of connecting cable

The second decision to make is on the type of connecting cable to use. You have a choice between familiar flat, 300-ohm twinlead and newer 75-ohm round coaxial cable. Coaxial cable is more expensive, but is less bothered by electrical interference because it is surrounded by shielding. It also is more rugged and longer lasting. It does however require a sensitive antenna and a powerful distribution amplifier as it introduces more signal loss than 300-ohm twinlead. Its advantage is that you can run it anywhere, even along metal pipes and heating ducts, without fear of interference.

If you decide on coaxial cable, you may need to add a small matching transformer between it and the antenna to match the cable's 75-ohm impedance to the antenna's 300-ohm impedance. This is inexpensive and simple to install. If your antenna has been up for a while, it's pretty safe to assume you'll need one. At the other end of the line, you'll need another transformer to convert the cable's 75-ohm impedance back to 300 ohms to match the input on the TV set or FM radio. This also has another function. It divides the VHF and UHF frequencies so you can feed the signals to separate inputs on TV sets that have provision for receiving both VHF and UHF channels.

match coupler to cable

Splitters and couplers come with connections for either 300-ohm twinlead or 75-ohm coaxial cable. Pick the type that matches the system you decide to use. Wall outlets are also available in a choice of connections. You can plug in either 300-ohm twinlead or a 75-ohm coaxial line depending on your system. Some offer a combination of outlets—one 75-ohm connection for a TV set and one 300-ohm one for an FM radio. In this case, there's a built-in transformer for the 300-ohm FM outlet, but you still need a transformer at the TV set for the 75-ohm line.

In shopping for parts, you'll probably come across a special wall outlet called a "tapoff." This is designed for systems in which all outlets are connected together in a continuous string instead of being on individual branch lines. It has some advantages for use in large apartment buildings, but is not needed in small home jobs and is more complicated to install as you have to calculate the signal drop from outlet to outlet.

In laying out your system, keep all cables as short as possible, especially the main downlead from the antenna. Mount the distribution amplifier as near as you can to where the downlead enters the house—preferably in the attic, if possible. The amplifier operates on house current and will need a 115-volt outlet nearby to plug into.

Be sure there's a lightning arrester between your antenna and the amplifier. A few amplifiers have built-in lightning-discharge protection, but even these will be better if they are protected by an outside arrester.

provide sufficient outlets

Two outlets per room are desirable, with more recommended for a large living room or playroom to give you flexibility in moving furniture around. The outlets are designed to fit into standard electrical wall boxes, but they can be clamped into wall openings with special clips, eliminating the metal boxes. You can also surface-mount them if you'd rather not cut openings in your walls.

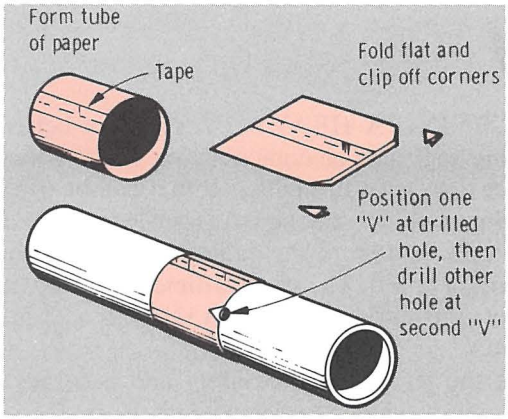
If you're using twinlead, don't run your lines near each other for more than a few feet as the interaction of signals between them can impair your reception. Also, you'll need insulated standoffs to support twinlead. Coaxial cable can be fastened directly to joists, baseboards and other surfaces with no problem.

The only tricky part about using coaxial cable is in preparing the ends for making connections. The shielding must be rolled back and a collar crimped on with pliers or a special crimping tool. You can usually rent or buy the crimping tool from the store where you get the parts. You can also buy cables with connectors already attached in 10, 50, 75 and 100-foot lengths. These are handy if they happen to match the lengths you need, but don't permit a lot of excess cable—that just wastes signal power.

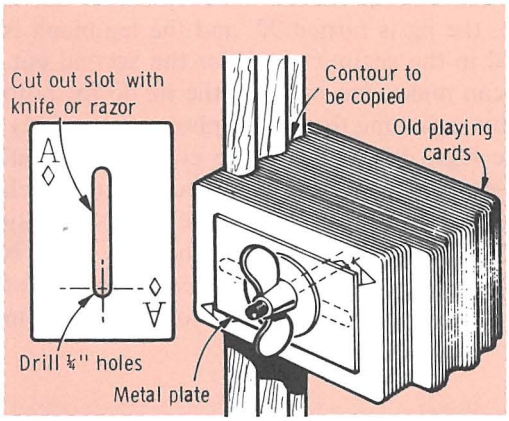
twinlead is easy to hook up

Twinlead is even simpler to attach—you don't have to strip off the insulation in most cases. You just slide the end under two serrated washers and tighten the washers down with screws. The serrated edges bite through the insulation and make contact with the wires.

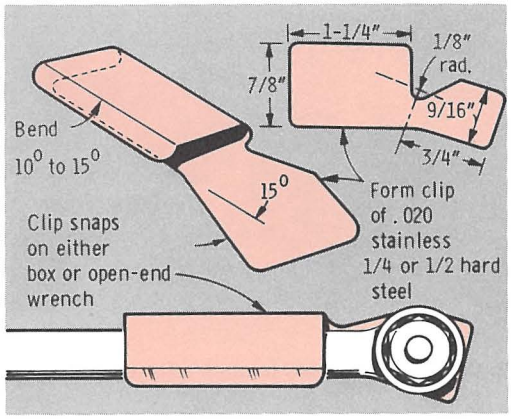
The nice thing about a MATV system is that you don't have to buy it all at one time. You can start with a simple splitter, then replace it with an amplified coupler later on, using the splitter in one of the branch lines. The system is so flexible that you can rearrange or add to it at any time as your requirements change without wasting any of the work you've already put into it.



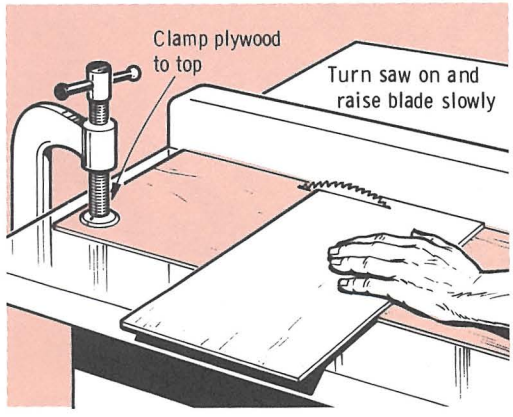
IF YOU'VE EVER attempted to use a portable electric drill to bore a hole through both walls of a pipe, you can understand the difficulty of aligning the holes so they are exactly 180° apart. One solution is to form a paper tube that fits snugly over the pipe. Fold the tube and then clip off both corners at an angle. When fitted over the pipe, the tube will have notches showing the exact location for drilling the holes.—*Stephen Stresnic.*



COPYING THE CURVES and contours around molding and other irregularly shaped pieces of wood can be accomplished accurately with the help of a few decks of old playing cards. Slotted as shown, the cards are held together by means of a wingnut and bolt or threaded rod of convenient length. Don't try to do without the metal end plates; they keep the cards flat and also enable you to draw smooth copies of the curve.—*S. Inserra.*

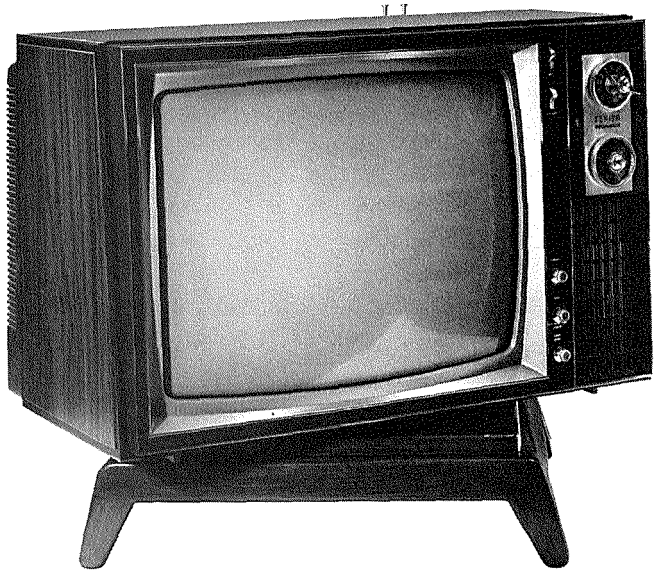


INSTALLING NUTS in small, tight spaces is extremely difficult without some means of holding the nut in the wrench. Members of one school tape a strip of sheetmetal to the handle of the wrench (admitting that this method soon becomes a nuisance). Another, and much easier, solution is to form this steel clip that can be snapped on and off in most standard-size open-end and box wrenches.—*F. Fehely.*



CUTTING A NUMBER of extremely small or narrow pieces of wood on a power bench saw is quite difficult because the opening around the saw blade tends to "catch" the pieces being cut. A fast and easy solution is to lower the blade and clamp down a new bed of thin plywood. Then turn on the saw and slowly raise the blade through the plywood. The result is a work surface without any openings to catch the work.—*Michael Ligocki.*

A turntable for your TV

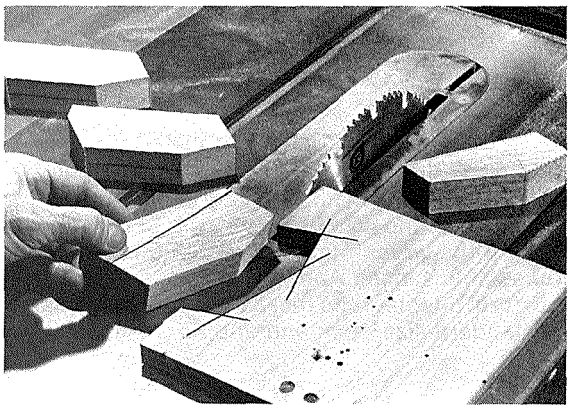


By JOHN NICHOLS

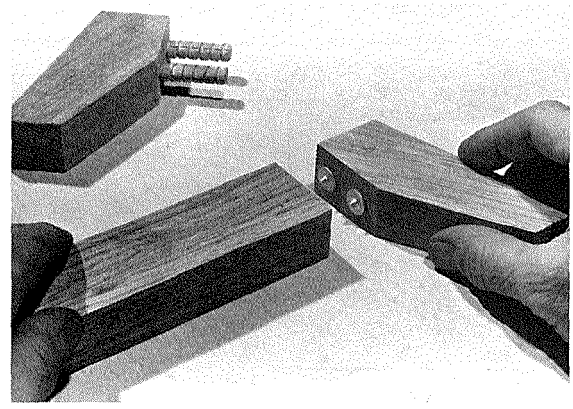
■ TURNING A HEAVY TV set for a better viewing angle can be done with one finger when the set rests on a turntable. With a ball-bearing lazy Susan swivel attached to a four-legged stand and to the bottom of the cabinet, the set easily turns right or left. The stand is dimensioned to fit the set; this one is made for a set with a 23-in. screen.

Cut the legs first. For safety and accuracy, make a jig as shown to ride against the rip fence and hold the leg blanks. After the first cut is made, the jig is turned 90° and the leg blank is placed in the second notch for the second cut. You can make one notch in the jig do for both cuts by reshaping the notch (photo, below left).

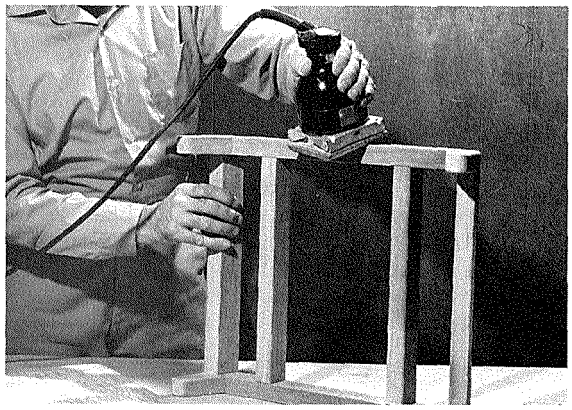
The legs, ends and middle crossrails are all blind-doweled. The ¾-in. plywood top to which the lazy Susan bearing is attached, is simply glued and screwed in place. When the stand is completed, center the swivel bearing on top of the stand, align the top access holes and bottom



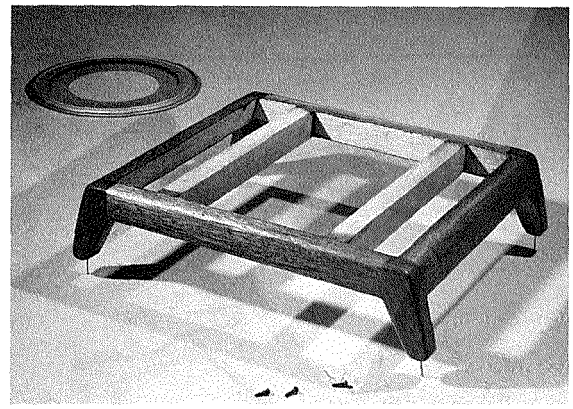
AFTER FIRST cuts, jig is reshaped for second pass.



DOWEL CENTERS are used to mark rails for drilling.

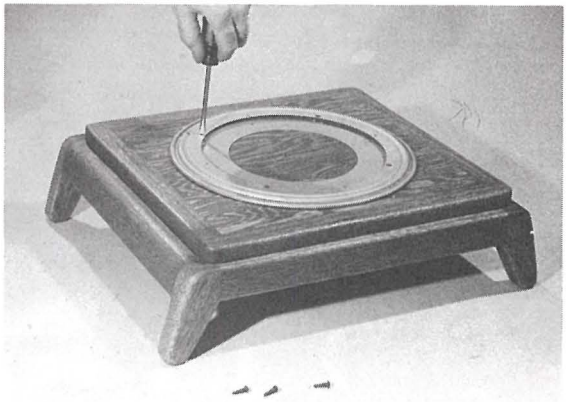


POWER SANDER is used to round frame edges slightly.

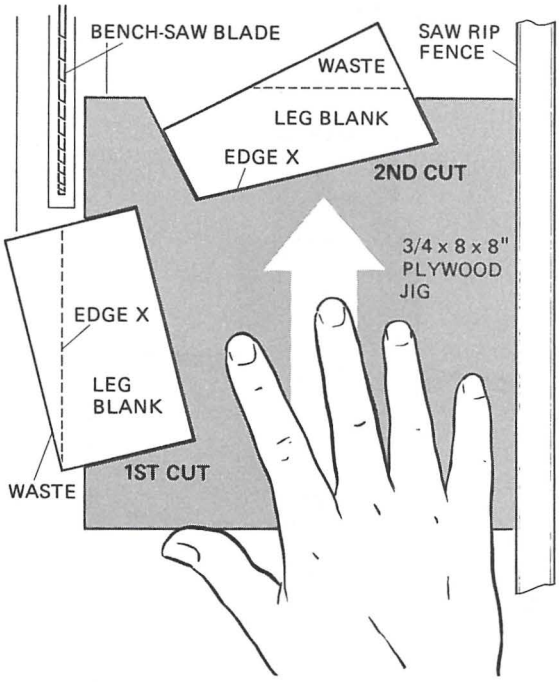


FRAME READY for top panel and lazy-Susan bearing.

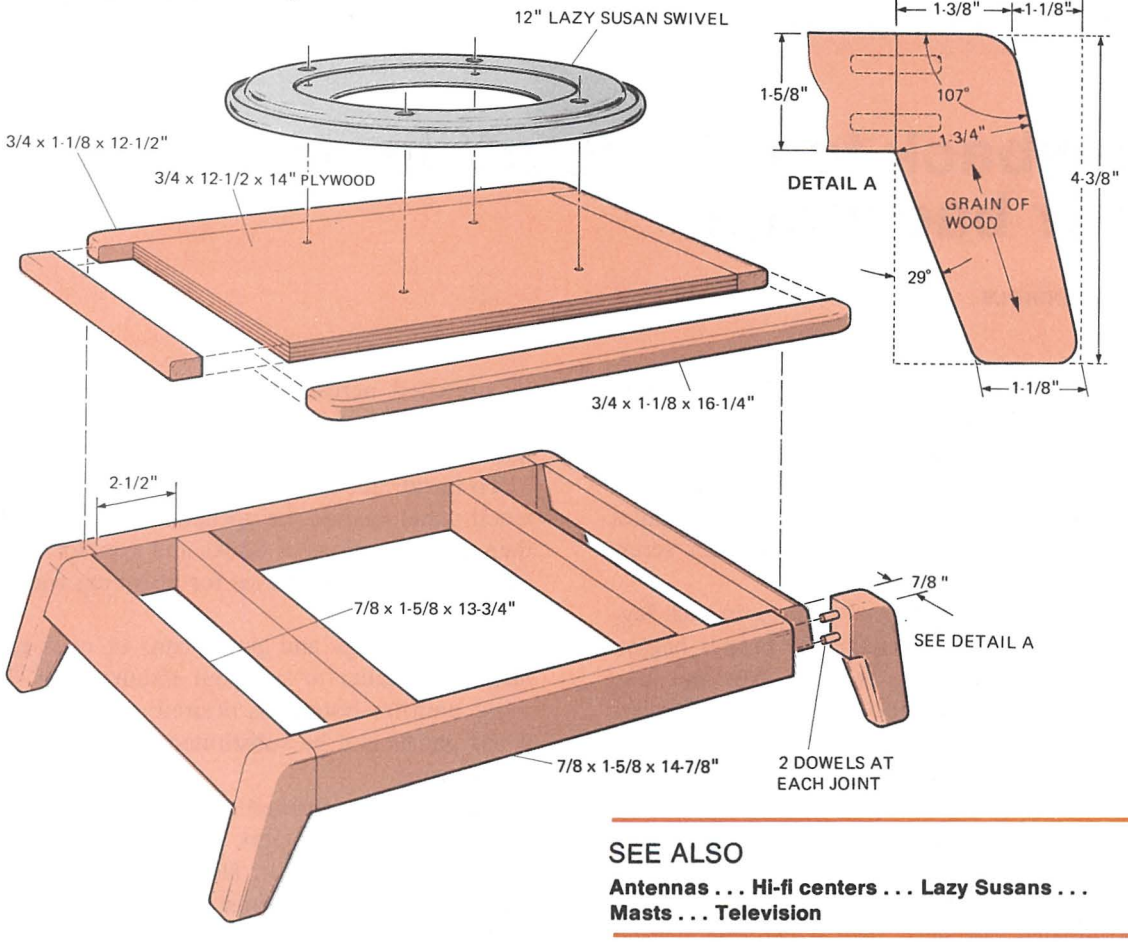
mounting holes and screw-fasten the swivel bearing to the stand. Match top and bottom access holes and bore four oversize holes through stand. Center the stand on inverted TV set and fasten swivel bearing to cabinet through holes in stand, using panhead self-tapping screws if the cabinet is metal, round heads if wood. *Caution:* Check inside TV chassis to be sure screws will not touch any parts.



ACCESS HOLES allow fastening from each side.

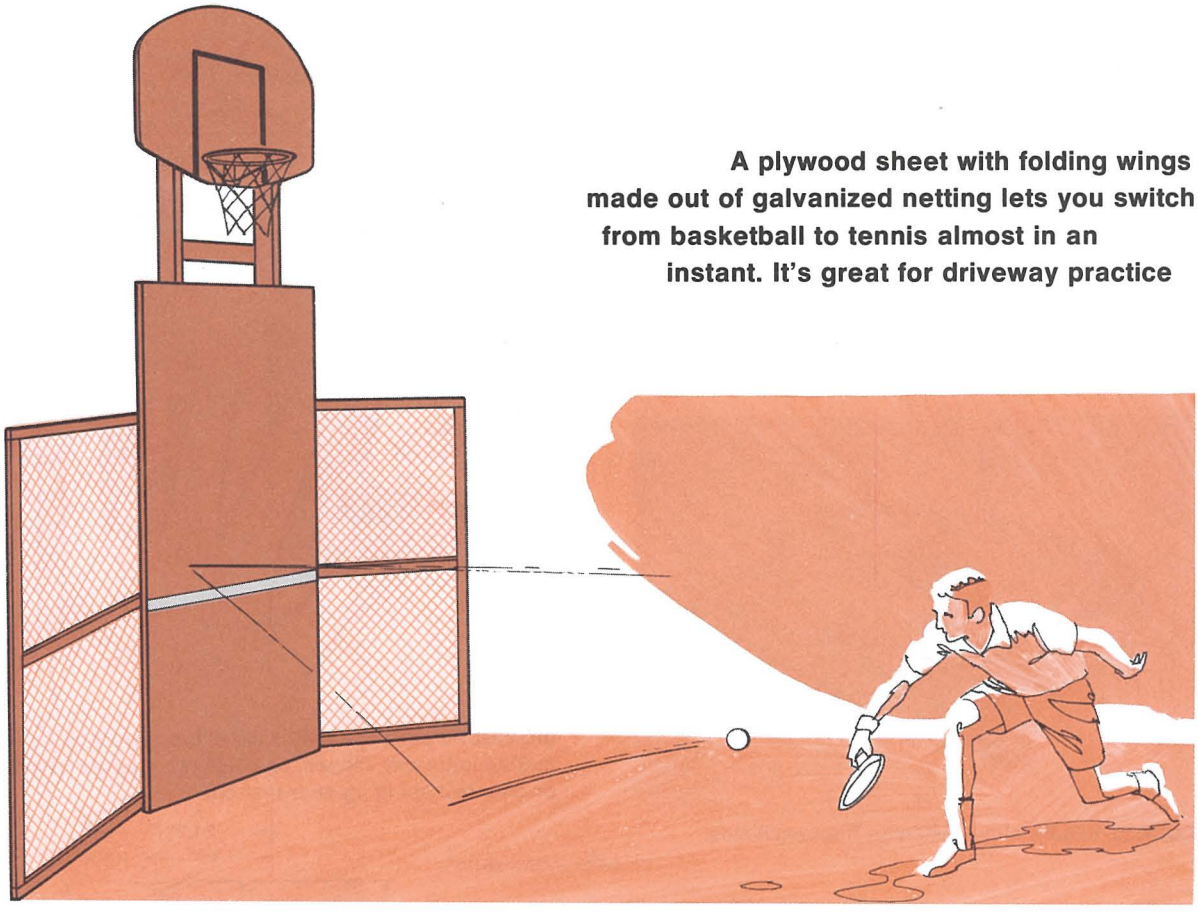


JIG HOLDS each block for a leg at the correct angle for cutting uniformly shaped legs. Use two cutouts (above) or one, reshaping jig after first cut.



SEE ALSO

Antennas . . . Hi-fi centers . . . Lazy Susans . . . Masts . . . Television



A plywood sheet with folding wings made out of galvanized netting lets you switch from basketball to tennis almost in an instant. It's great for driveway practice

Playback tennis 'court' improves your backhand

By L. H. NICHOLS

BASKETBALL FOR THE KIDS and tennis for you—or vice versa. This unit lets you practice both, combining a regulation-height basket and backboard with a removable tennis practice wall. You can switch from one to the other in minutes because the tennis wall is attached with screw hooks and eyes.

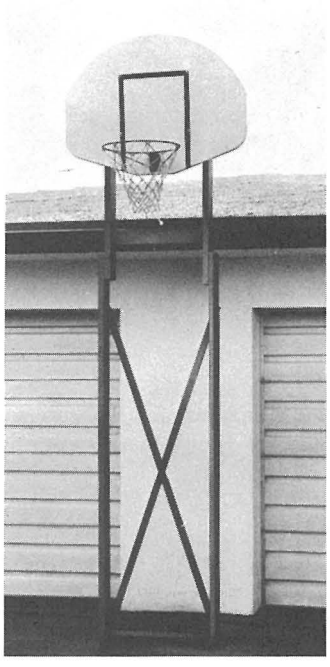
Uprights are 2x6s, spliced with ½-in.-dia. lag-screws, if necessary, to make the proper height. Diagonal cross members are also 2x6s and may be mortised into the uprights. A 2x4 crossbar and toggle bolts secure the unit to the overhang of house or garage. Basket and backboard, purchased as a unit, are attached to uprights with screws so that the basket rim is 10 ft. above the ground.

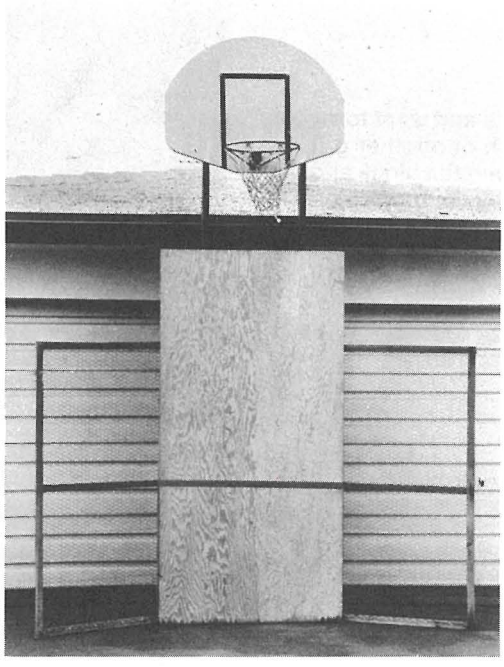
Wing frames of 1x2s are assembled with nails or corrugated fasteners; then galvanized netting is stretched across framework and stapled in place. Lattice strips may be used to conceal netting edges.

To install hooks and screw eyes, hold the plywood panel against the uprights to center it, and then mark locations of hooks and eyes for a tight fit. Locate hooks and eyes for attaching wings to plywood similarly.

Sizes of wings and panel can, of course, be larger or smaller to suit your requirements. If a more uniform bounce is desired, two more plywood panels can be substituted for the wire-on-frame wings.

Wood can be allowed to weather, or finished to your taste with latex house paint, exterior enamel or spar varnish. Don't forget to paint a line across panel and wings at net height (3 ft. at center).

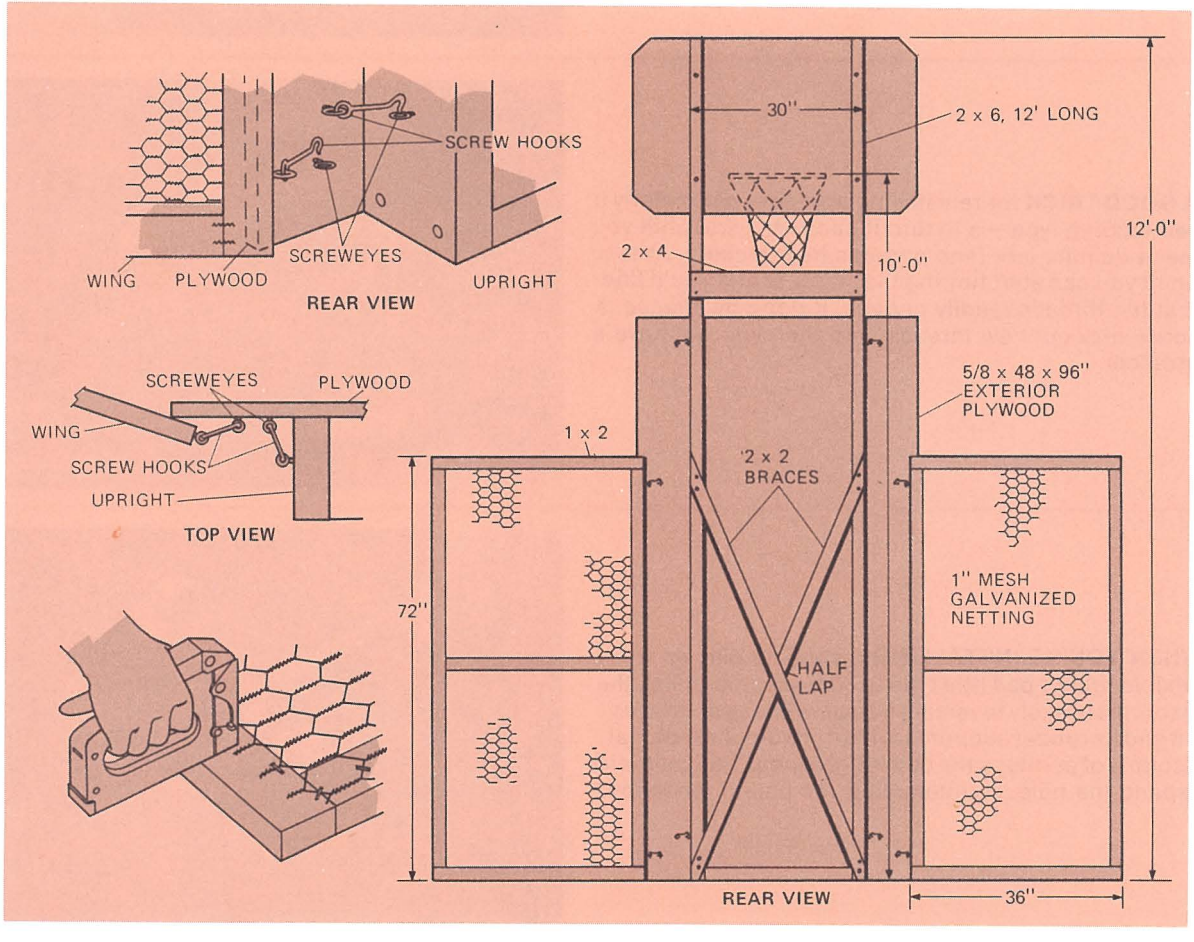




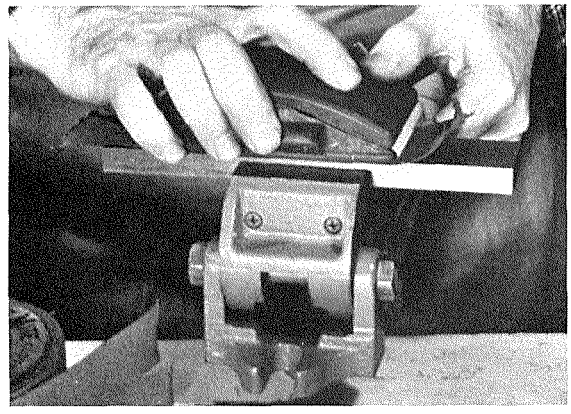
CONVERSION from one sport to another is nearly instantaneous. Tennis setup (near left) gives a lot of area to hit ball. For basketball practice (far left) the backboard uprights are clear of the tennis netting.

SEE ALSO

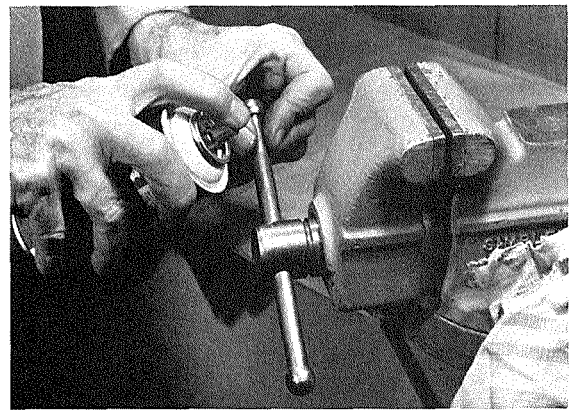
Asphalt driveways . . . Yard lighting



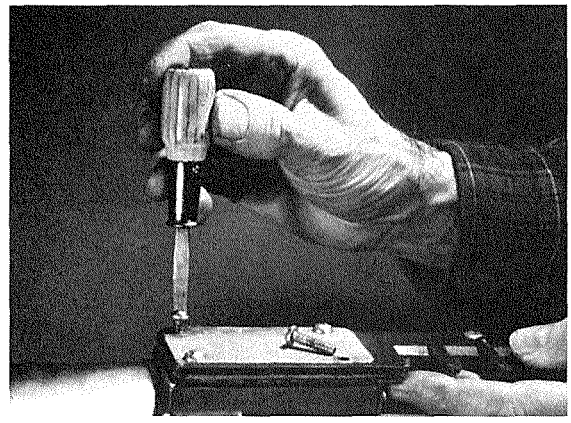
IF YOU ARE using a sanding block and want to switch quickly to abrasive paper or cloth of another grit, simply place the new piece between the block and the work. The abrasive already held by the block will grip the back of the new piece firmly enough for normal sanding.



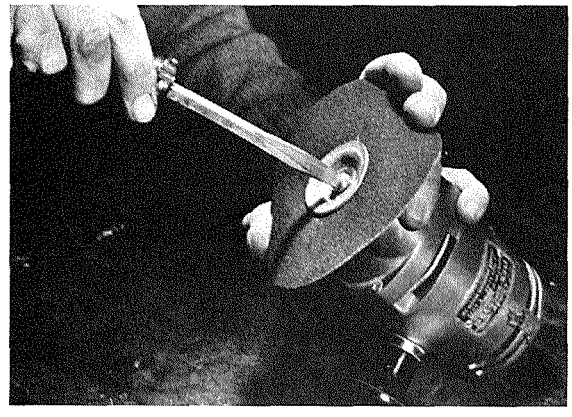
THERE'S NO DOUBT that an often-used vise will soon have a sticky handle due to an accumulation of dirt and grease. One way to remedy the problem is to apply a solvent such as lacquer thinner to soften the gummy mess. Slide the handle back and forth until it works freely and use a rag to wipe off the softened dirt.

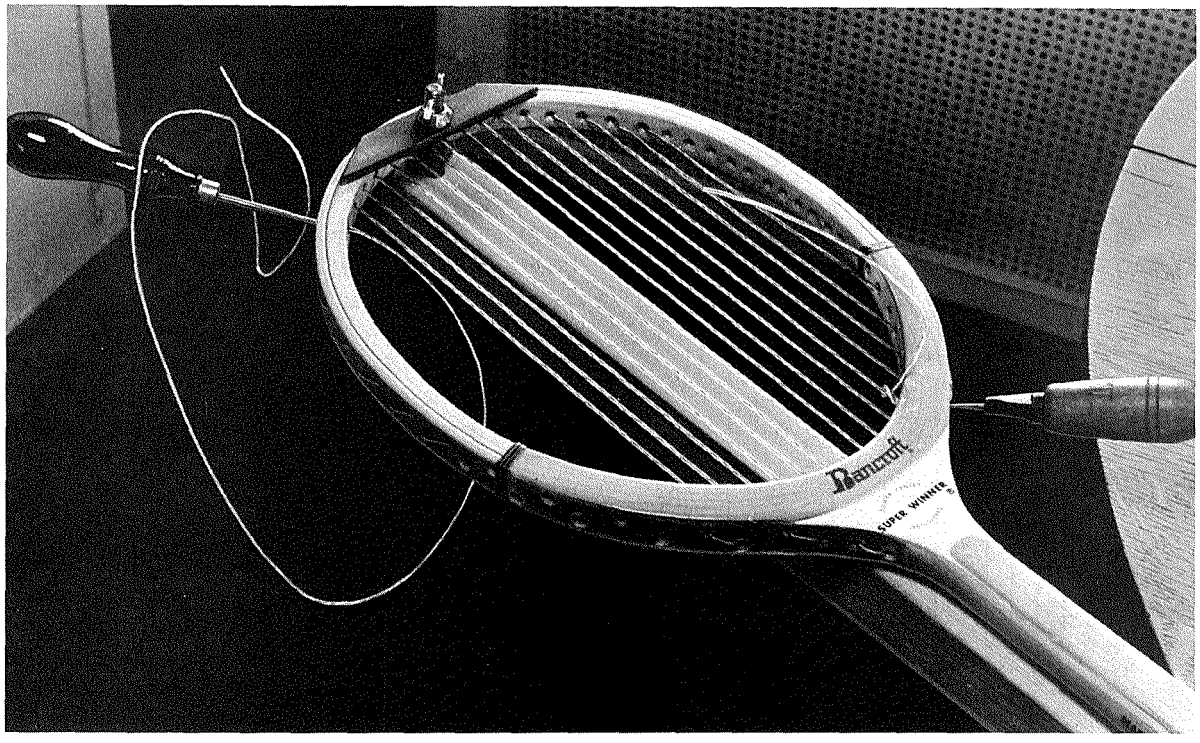


A GOOD TRICK for reinstalling a screw—particularly a self-tapping type—is to turn it backward first until you feel a definite jerk (and perhaps hear a click). At this point you can start turning the screw in and you'll find that the threads readily engage. If done by chance, a screw may cut new threads, and then you will have a problem.



WHEN YOU'RE INSTALLING a sanding disc on a flexible rubber pad (the type used in electric drills), the disc is more likely to remain free of wrinkles or "waves" if it and its rubber support are bent toward the motor at a couple of points as the bolt is tightened. This seems to expand the hole, counteracting the pull-in tendency.





SIMPLE JIG for holding racket is length of wood and clamps, turns table into rig for racket repairs.

Restring your own tennis racket

By ELMER K. NORTON

Using these simple techniques and tips, and a little practice, you can save playing time—and money. You'll be pleased at what surprisingly good results this system gives. Use it on badminton rackets, too

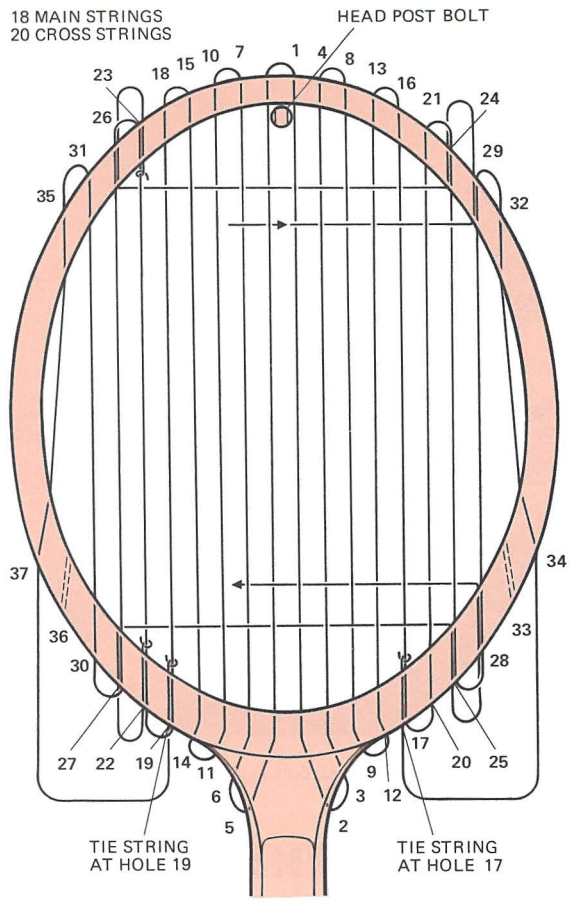
IT'S SATURDAY MORNING and during a warm-up rally you pop a string on your favorite racket. No need to give up the weekend matches or play with an uncomfortable borrowed racket. If your restringing and repair shop is closed or miles away, try some of these simple shortcuts I've developed over 25 years.

Less than $12 can provide you with a jig to hold the racket and materials for restringing and replacing your grip as well. Sending your racket out for restringing alone might cost you $10 to $13 in nylon, $20 to $24 in gut. A professional restringing machine can cost over $400.

Materials you will need for the method shown here are simply a three-foot length of 1½x1½ stock, preferably hardwood, an eight-inch length of 1½-inch dowel (like that on which rugs are sometimes delivered) that you will cushion with a wrap of leather or adhesive tape. Also two three-inch or four-inch "C" clamps to hold the wood base and your racket to your workbench or kitchen table plus a four-inch ⅜-16 NC hold-down bolt with wingnut to secure the head of the racket, and some scraps of hardwood so the clamps don't scratch your racket handle. A couple of awls from a hardware store will hold the string in place.

I recommend nylon string in a 35-foot length from your tennis shop or mail-order supplier, at about $4.50 or $5, for your 18 main and 20 cross strings. Nylon lasts several times longer than gut and is much easier to work with. Mail-order sources include The Tennis Center, 68 Harrison Ave., Congers, NY 10920, and Tennis Accessories, 616 Schreiber Ave., Coplay, PA 18037.

Clamp down your racket, as shown, with the



restring your racket, continued

side grooves slanting down and toward the head of the racket. All strings always go into the lower hole and out the upper hole of the groove. Starting with the main strings, the vertical ones, cut a 19-foot length of nylon and thread through the two top holes so that half (9½ feet) goes on each side of the center-post bolt holding the racket head. The bolt is filed flat on each side to protect strings from damage. Thread these main strings down through the first holes on each side of the neck.

Sight through these holes to see their direction and then carefully but firmly insert one awl into No. 1 to hold the string in place. Wrap the string coming out hole No. 2 one and a half turns around the string-tightening dowel handle and, using the frame for leverage, turn to tension the string. Be sure the string coming out is straight so you are not tightening against added friction. Insert the second awl in hole No. 2 and remove the tightening handle. Thread the string through holes 3 and 4, tighten, and insert the awl in hole 4. Repeat this procedure on the other side through holes 5, 6, 7. Awls are now in holes 4 and 7.

Continue this threading and tightening process alternately in numerical order, as shown, until there are 16 strings threaded and awls are in holes 29 and 31. Strumming each string as it is tightened will give you an indication of proper tension. Thread 32 and 34, then 35 and 37, being careful to skip holes 33 and 36. Pull strings extra tight, insert awls, rethread those loose ends through holes 17 and 19, and tie off each with a simple half hitch. If the nylon is slippery, add an extra half hitch; then cut off excess string ¼-inch from the knot.

threading the cross strings

Cross strings are threaded from the remaining 16-foot length. If hole 22 is a top hole, thread one end up through and half hitch to the main string there. If a bottom hole, No. 20 on the other side must be used instead. Thread the other end through hole 27 and weave under and over the main vertical strings over to and through hole 25 on the opposite side. Tighten, insert awl and continue weaving across and up the racket until 20 cross strings have been strung. The 20th string goes through hole 26, is tightened, threaded through hole 23 and then tied to the main string there and cut off. During cross-string threading when a main string already occupies a hole, it's helpful to sharpen the tip of the cross string; snip it off diagonally to a point.

Now go over the racket with a slim dowel or pencil (since your awl might cut into a string) and straighten those strings out of line so that they all cross at right angles and are parallel.

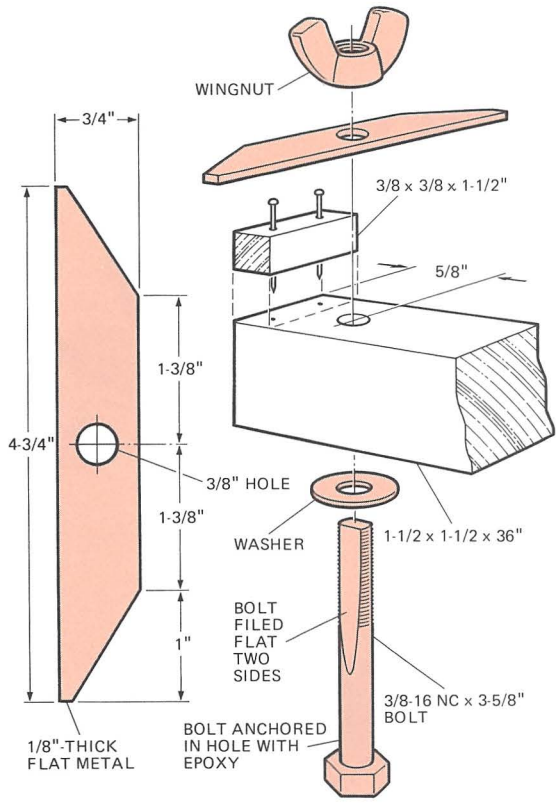
Grip replacement is also not too difficult—once you know how. A good quality leather grip, about 3½ feet long, is approximately $3 from a sporting goods store or tennis shop. Remove the old grip, and coat the handle with mucilage or shellac. Air until tacky. With a ⅜-inch flat-headed nail, secure the tapered end of the grip strip flush with the butt end of the handle, nailing through ¼ inch from the end of the leather. Hold the racket head between your legs and wrap the grip flush around the butt end and then on down the handle clockwise with the leather layers butting or slightly overlapping, if so designed. Tack the finished end with a ⅜-inch nail, trim off excess leather with a razor, and cover the nail and edge with two or three turns of ½-inch plastic tape.

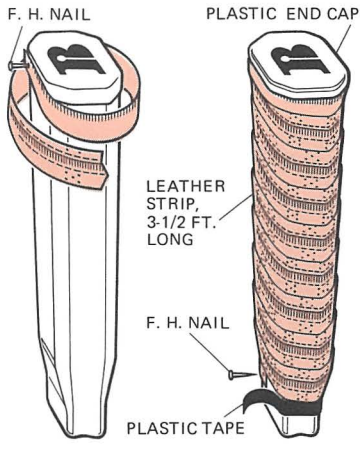
Gut restringing can be attempted after you have become proficient with nylon. Because of gut's

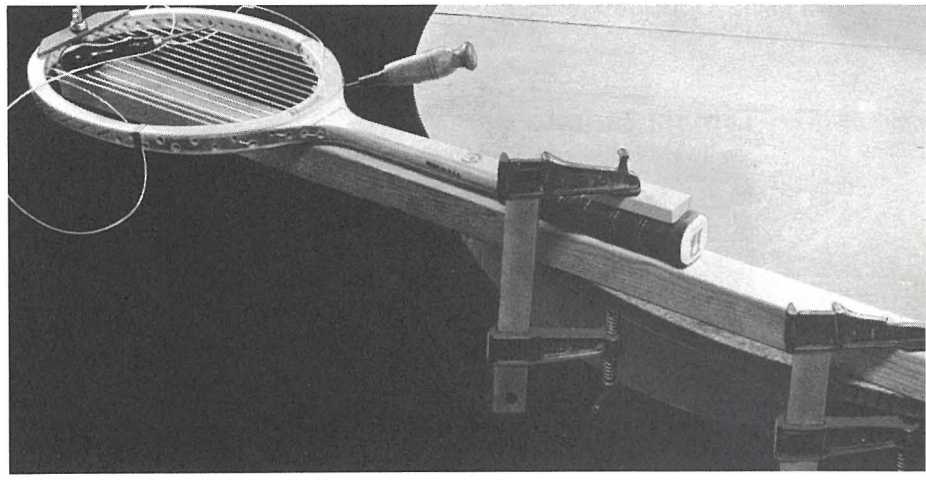
reaction to moisture (a rain shower can ruin its tension), it should be treated with preservative after stringing and occasionally during active use after exposure to damp conditions or when the strings are becoming slightly frayed.

Mix one part of white three-pound cut absolute shellac with five parts of water-free ethanol in an 8-ounce salad dressing jar with screw top. Store a ¾-inch brush with cutdown handle inside the jar. When strings are frayed or damp, first dry with talc or a fluffy towel, then paint on a light coat. Thin mixture with alcohol from time to time. Too thick a coat or too frequent use makes gut strings lose resiliency. Never use it on any type of nylon strings.

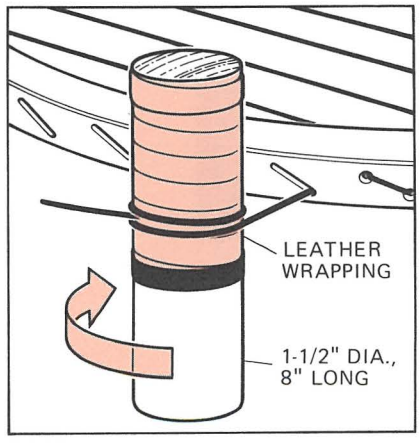
The stringing method outlined here can also be used with all metal rackets except the Wilson Steel and Seamco Aluminum. The rig works as well with squash, paddle and badminton rackets, although badminton strings are 19-gauge and much thinner.

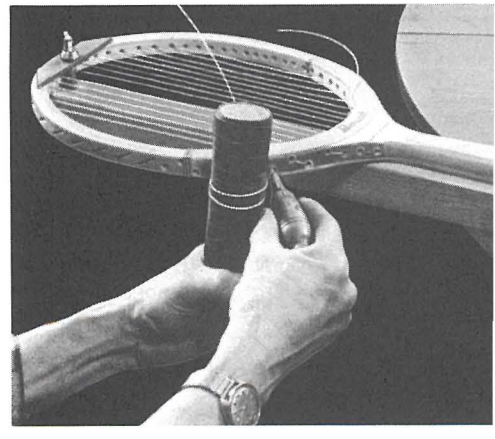






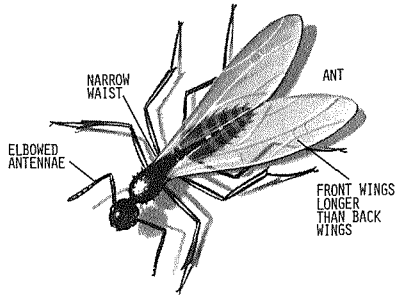
RACKET JIG uses bolt cap (at upper right) to hold the head of racket plus C-clamps to secure a brace to the table. Renewing grip (above) starts with a leather strip 3½ feet long which is stretch-wrapped down the handle and finally secured with a nail and a plastic tape ring.

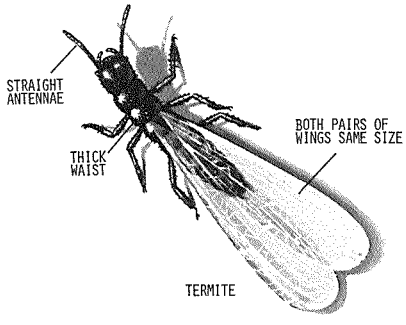




TENSIONING OF NEW STRINGS (right) is done with a 1½-inch-thick dowel with leather or adhesive wrap. The string is looped around the handle and is turned to tighten, held with an awl while the next length is laced in place. Cross strings weave under and over the main strings.

What to do about termites

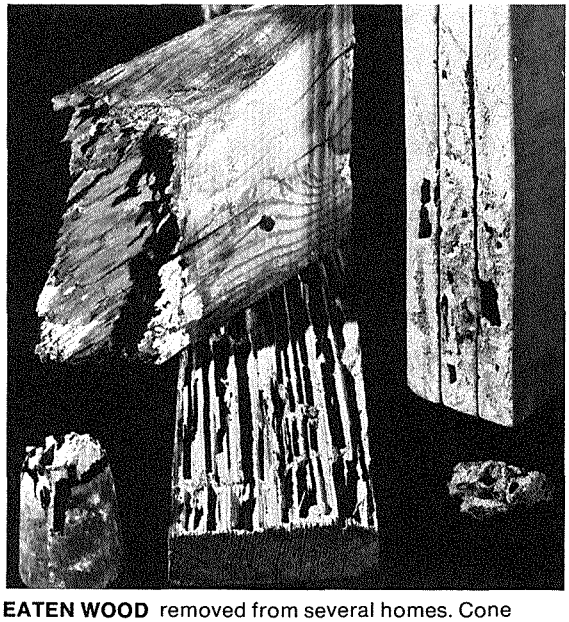




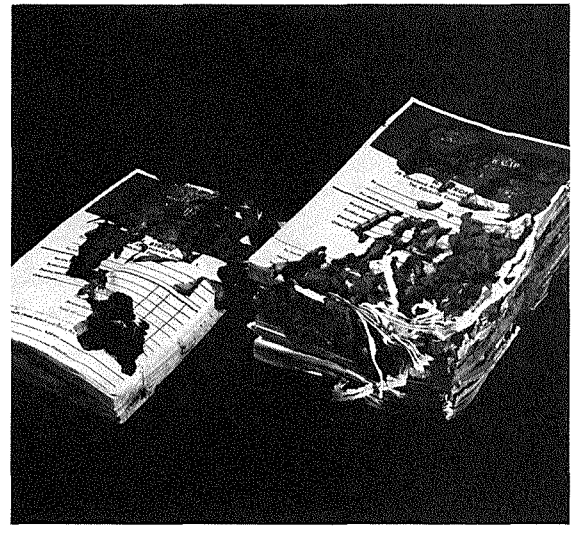
HOW TO TELL ANTS from termites. Since you can't escape from them—termites are active in every state but Alaska—it's money in your pocket in repair savings if you can recognize them early. The sketch at left shows differences between the insects.

■ BOB VERNON DISCOVERED that his first-floor joists were infested with termites when he was having his basement remodeled. Until then, he didn't realize that the floors in the kitchen and the second-story bath were sagging because of termites. By the time his "education" about his uninvited guests was completed, he had to lay out hundreds of dollars in termite-control fees and nearly as much to have carpenters repair those eaten joists and beams.

Typical termite damage



EATEN WOOD removed from several homes. Cone (lower right corner) is a termite structure.



ORDER PADS (above) were stored in a basement. The termites enjoy paper as much as wood meal.

SEE ALSO

Home buying . . . Home improvement . . . Tile, floor

Mrs. James Floyd was first aware of the insects when she spotted some silver wings in a cellar window well. Before she was through protecting her home a complete professional treatment cost her more than a year's heating bill.

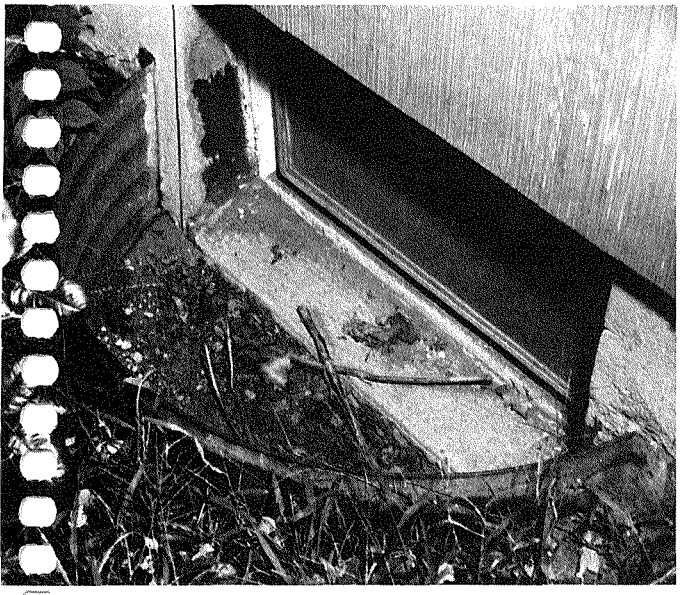
Though these names are fictitious, both termite cases are true and were observed first-hand on Long Island, NY. The list could go on and on. An estimate in the early '70s of total annual damage by this voracious pest was $500 million. What's more important: If your home is attacked, *treatment and repair* can cost you plenty.

Dr. David L. Watson, entomologist for Velsicol Chemical Corp. in Chicago said, "Each year 20 million American homes are damaged—some of them severely—by colonies of termites." And he adds, "Approximately only two million of these are treated."

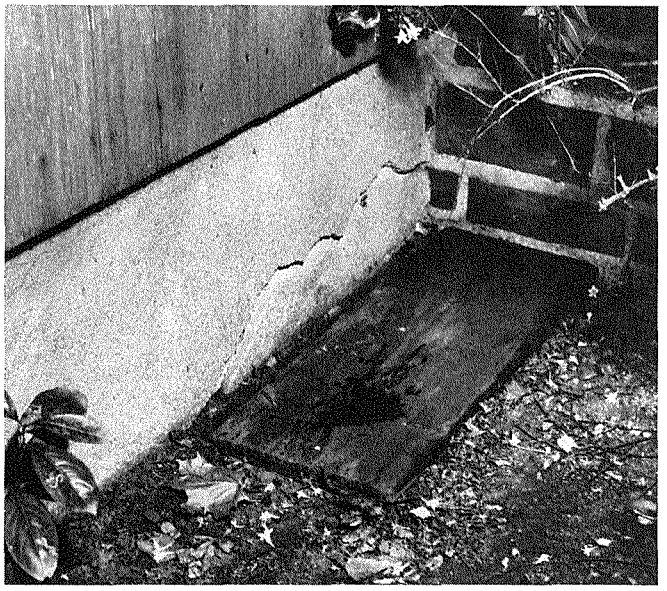
Three main factors contribute to this costly oversight by homeowners:

- *Homeowner lack of ability to detect the early presence of termites.*
- *Fear of selecting a fast-buck operator when calling in a pro.* A reliable pest-control specialist will inspect your home at no cost to you. (For

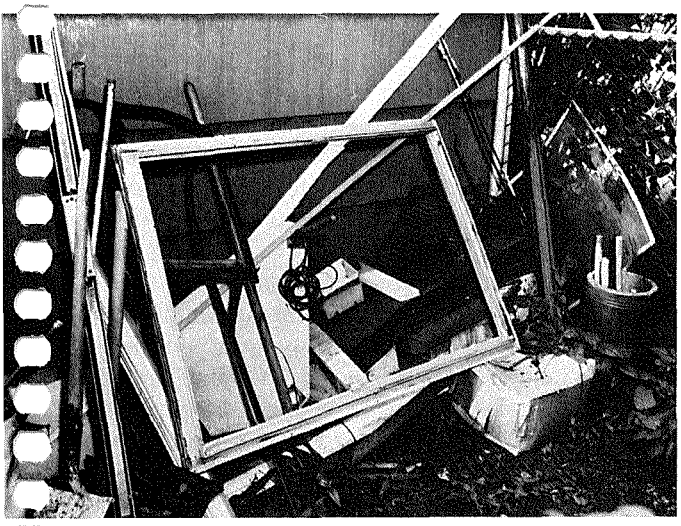
Conditions that invite termites in for a feast



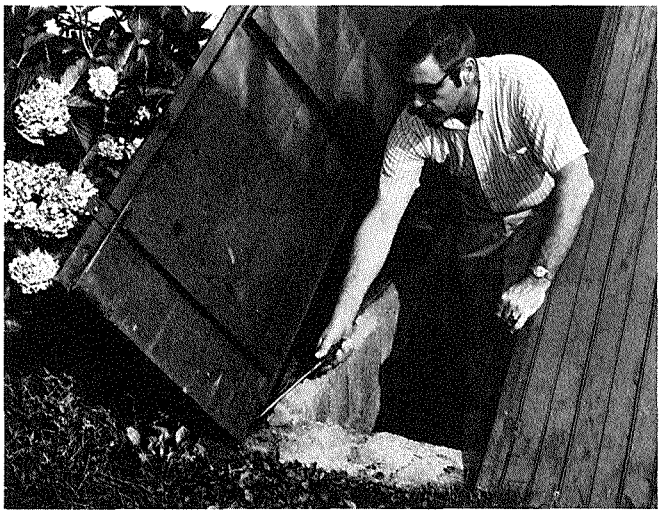
WINDOW WELLS, if not kept clean, provide ideal entry for termites through the wood window frames.



PLANK ALONGSIDE FOUNDATION WALL with crack is another open invitation for the hungry attackers.

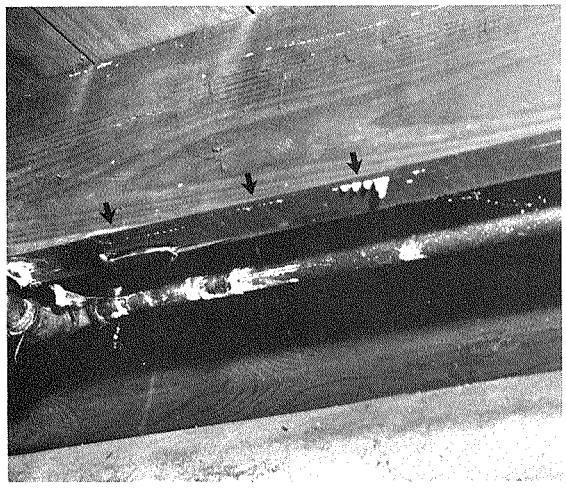


PILES OF TRASH AGAINST HOUSE give the insects more than adequate protection from birds of prey.

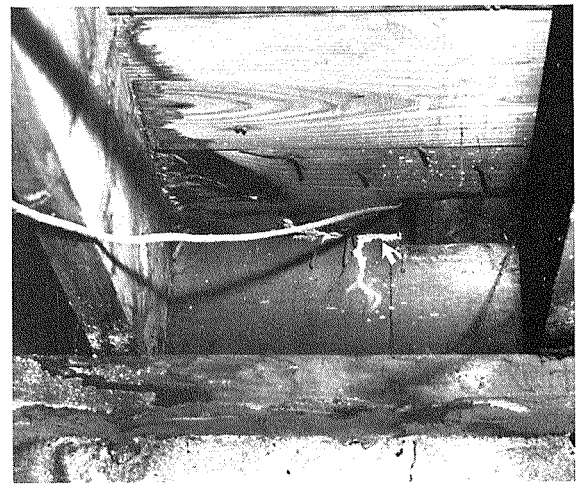


EXTERIOR CELLAR ENTRANCE with wood sole plate in earth will almost guarantee attack by termites.

Sure signs of termites



TERMITES OFTEN TRAVEL along surface of joists by building mud tubes to create livable environment.



MUD TUBES ALONG SILL show that termites are headed for better feeding grounds on the first floor.

ANYWHERE WOOD meets grade, termites may be found. Here, wood actually appears to be rotted.

resale inspections, there is usually a fee.)

• *The "embarrassment" of having termites in your home.* Because the presence of a PCO (Pest Control Operator truck) in the driveway is considered a stigma by many homeowners, they wait too long to call in an expert. Actually, the real embarrassment is to have bugs and do nothing about it.

Subterranean termites, which do over 90 percent of insect damage to buildings, avoid air because they become dehydrated. Thus, they build mud tubes and structures to maintain humidity suiting their environment.

This is why they are usually never seen—except at "swarming time" in early spring or fall, usually on a warm day after a rainfall. Swarming normally occurs once a year in northern states and twice a year in the South. The swarmers drift on the wind for up to a mile, until the queen and her cohorts find a site for establishing a colony. Once the swarmers drop their wings, they start to burrow in the earth for moisture. Termites do not live in a house; they nest below it in the soil. Unlike carpenter ants, they do not leave a sawdust trail; they digest all cellulose in their woodwork, fabric and paper meal.

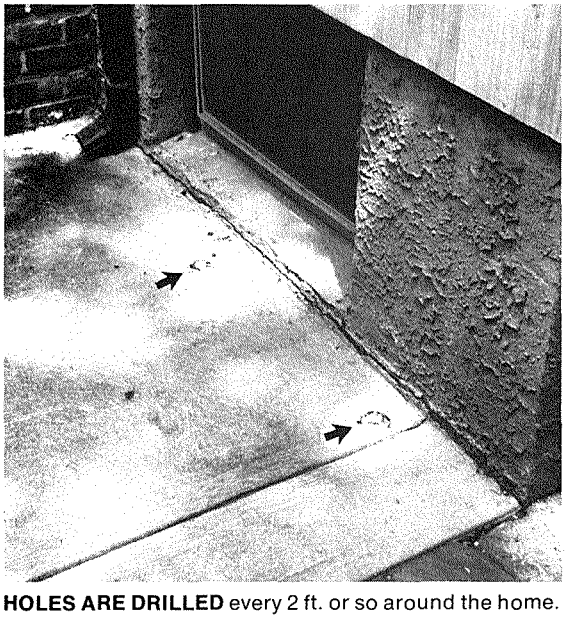
What a homeowner can do. First, keep the foundation free of any debris which can protect the pests from the air and preying birds. Second, it's wise to check periodically any wood members near the earth, such as the basement entry and wooden frame window in the photos, or garage-door framing. For some unknown reason, in new construction it is a fairly common practice to jamb out and trim a garage-door opening before pouring the slab and driveway. Termites then have a direct route to the home because the jambs pass through the slab and rest on the earth.

Several chemicals are on the market for do-it-yourself use by homeowners. The manufacturers recommend an annual spraying or pouring of these chemicals around the foundation. Think twice before using them. Certain ones are banned by law in some states. Keep in mind that some chemicals can be as poisonous to human beings as to insects. If you use chemicals yourself, instead of calling in the professionals, don't store leftovers where children can reach them,

Exterior treatment

PROS GIVE STEPS EXTRA-HEAVY DOSE of chemical, since steps are especially prone to termite attacks.

PCO EXPERT feeds chemical behind brick to treat the void between the veneer and the sheathing.



HOLES ARE DRILLED every 2 ft. or so around the home. Photo above shows several in the concrete.

AFTER DRILLING, chemical is pressure-fed into each hole. Those in concrete slab are then patched.

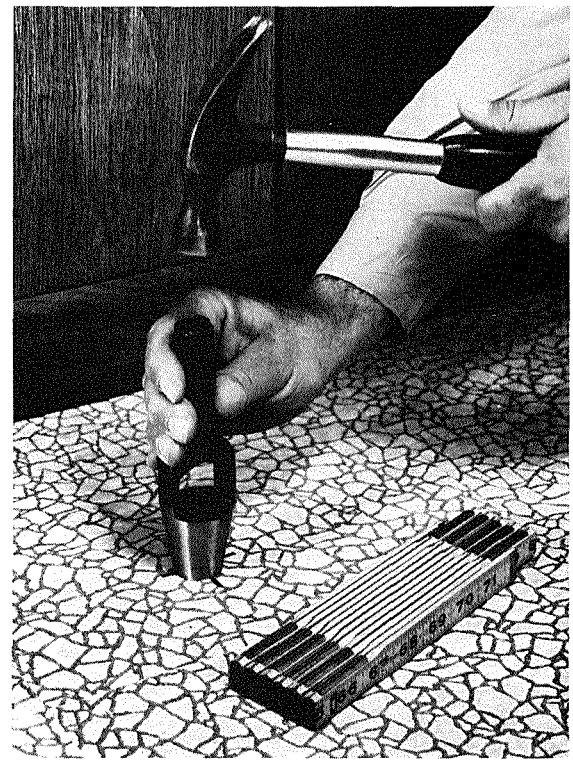
and bury the empty containers on your own property, rather than putting them with the rest of the garbage for disposal at the local landfill. *Read labels carefully and follow the manufacturer's instructions.*

Other than this preventive maintenance, your best bet is a professional PCO. After several days with Steve Schwimmer of Fumex Sanitation Inc. of New Hyde Park, NY., I learned that the legitimate specialist has the homeowners' interest at heart. Great care is taken to do the job as quickly as possible—without sacrificing thoroughness—and to return the home in as near its original shape as possible. How well they do this, indoors and out, is shown in the photos.

What the professional can do, that an average homeowner cannot, is a *complete* job. Inside or out, he can get to the termites through the use of sophisticated equipment. He'll treat all soil *around and under* your home with a modern scientific chemical. (The outfit I traveled with

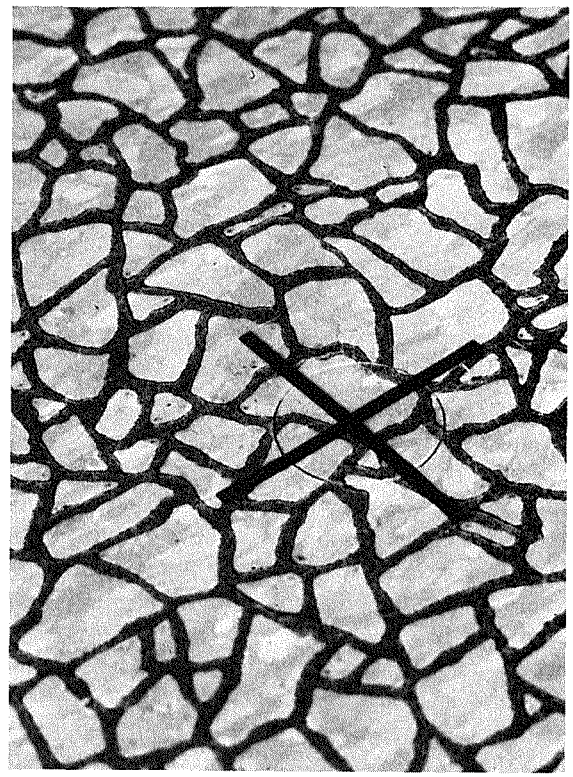
Interior treatment of slab floor

1. FLOOR TILES are heated with a flameless heat gun to soften spot to be drilled for chemical treatment.

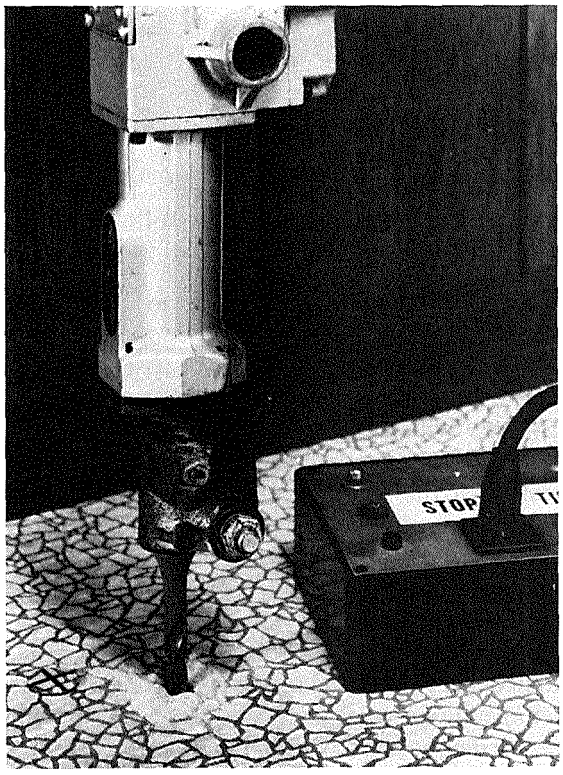


2. PUNCH, rapped with hammer, makes clean cut. Tape in shape of an X is for clarity in spotting plug.

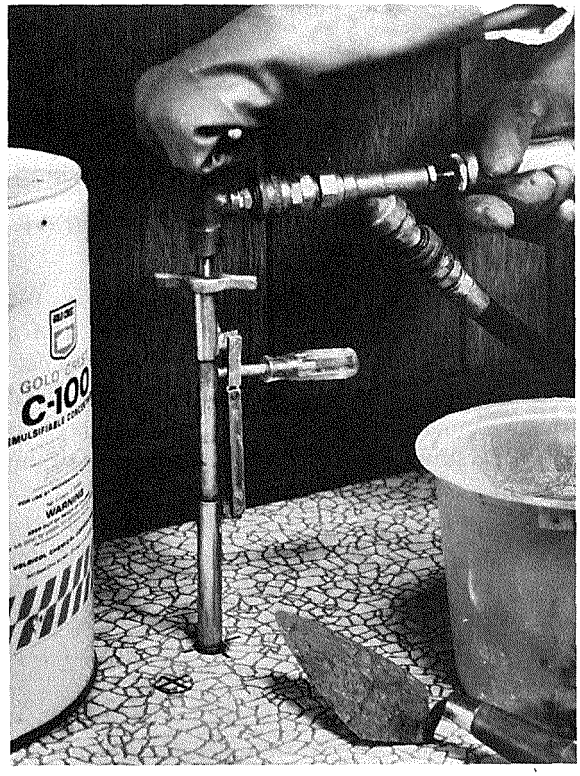
5. TILE CUTOUT is replaced after the concrete slab is patched. Care is taken to align the tile design.



6. X MARKS THE SPOT where the treatment occurred. Without it, cutout in the tile is virtually invisible.



3. CONCRETE SLAB is drilled; electronic stop device in foreground turns off drill if near a conduit.



4. CHEMICAL is forced into holes; an expandable rubber flange around shank prevents any splashback.

7. WITH X REMOVED, treated area will go unnoticed. Same result by a homeowner is virtually impossible.

used Gold Crest chemicals.) This treatment will create a termite barrier that will last a minimum of five years.

The foundation is treated down to its footing (see photos showing exterior work). Steps and concrete slabs that butt the home are protected by boring holes and then pressure-feeding the chemicals through them to saturate the earth below. The pest-control operator will repair the "damage" that occurs during the job—for example, the holes in slabs—and clean up afterwards so it's virtually impossible to detect signs of treatment. Most operators, however, are not carpenters. Thus, repair of termite-eaten joists, sills, flooring and the like will require a carpenter's service after a treatment.

Tips on avoiding termite infestations:

- Keep wood away from the foundation.
- Seal foundation and basement floor cracks to eliminate passageways.
- Make an inspection at least once a year. And if you have the least doubt, call in a specialist; a periodic inspection might save you a lot of money later.

A simple test for shutter speed

By CHARLES WELCH

Is your camera really on the beam? Checking shutter accuracy is usually a job for a pro, but it's easy with this ingenious trick of using a phonograph record and turntable as a timer

■ IT'S EASY to take shutter speeds for granted. You set your camera for 1/200th of a second and you assume that that's what you get. But is it? Shutter timing is delicate. A tiny bit of dust or moisture can throw it off as much as two or three stops—and you won't know it until the pictures come back ruined.

Here's a simple way to check your camera without sending it off to a repair shop. All you need is a phonograph. Mark a white line on an old record, as shown, then spin the record on the machine and photograph it at each shutter setting.

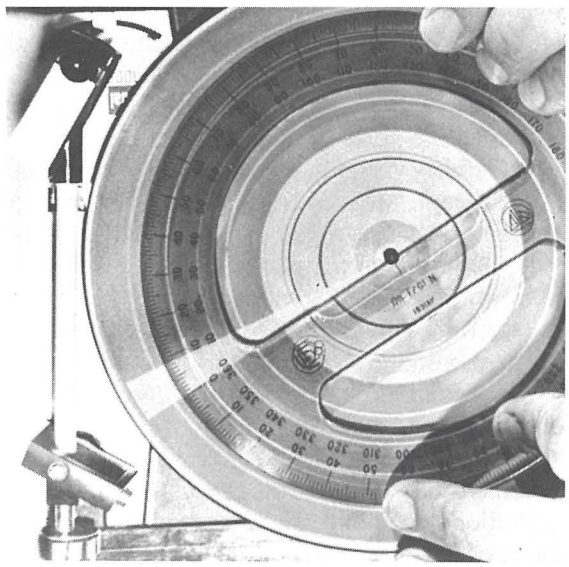
The moving white line will show up as a blurred wedge on the film. By measuring the width of the wedge on an enlarged print, you can tell exactly how long the shutter was open at each setting. For example, at 78 rpm, a phonograph turns 1.3 revolutions a second, or 468°. This means it will rotate 46.8° in 1/10th of a second and 4.68° in 1/100th of a second. Even the wedge produced by 1/1000th of a second—approximately half a degree—can be measured accurately with a large protractor.

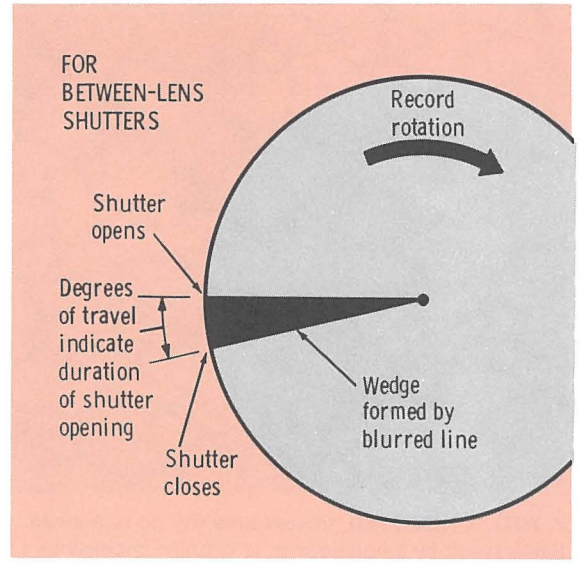
The accompanying table gives the degrees of travel for the most common shutter speeds. A 78-rpm speed is best for short shutter openings because it gives you a bigger, more easily measured wedge. If your shutter settings are different from those listed, you can easily figure out your own table of wedge widths. Just divide the total degrees of travel in one second by the shutter speed you want to check, and the result will be the degrees of travel for that particular speed. If you have a focal-plane shutter, note the special procedure for measuring the curved wedge that results.

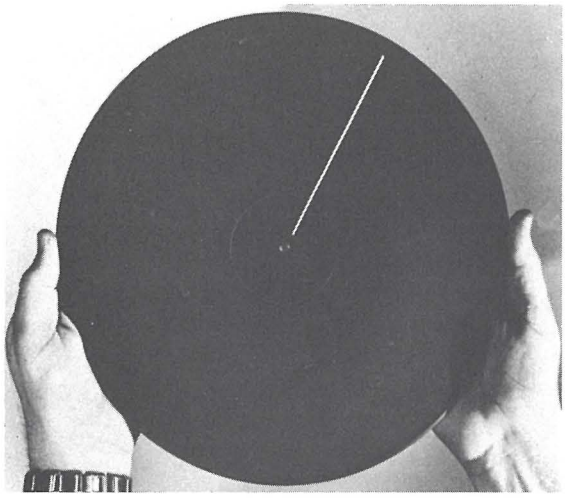
Shutter speeds that aren't off by more than 25 percent are considered acceptable. Often a sluggish shutter can be cleared merely by snapping it a few times. If serious errors persist, have an expert repairman readjust the shutter.

SEE ALSO
Cameras, care . . . Lenses, photo . . . Photography . . . Photo hints . . . Used cameras

WEDGE-SHAPED BLUR on the film indicates how long the shutter remains open while the record turns. Place a protractor over the wedge and carefully measure its width in degrees at the rim of the record.





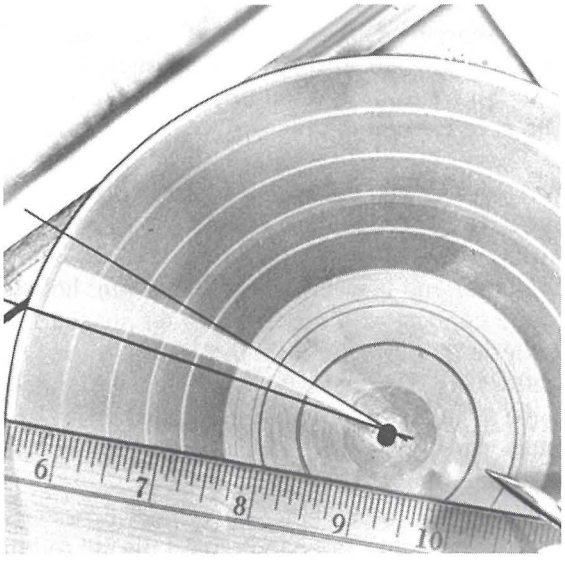


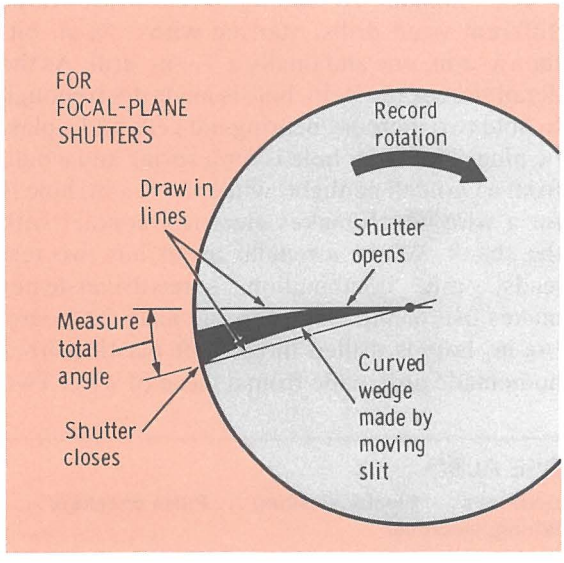
MAKE A TEST disc from an old worn-out record painted flat black to cut down reflections. The white line should be about 1/16 in. wide, can be a strip of white tape or paper. Setup at right shows how the camera is positioned directly over the phonograph.

SHUTTER TEST TABLE

SHUTTER SPEEDS (seconds)	TURNTABLE SPEEDS 33⅓	45	78
1	200	270	468
1/2	100	135	234
1/10	20	27	46.8
1/50	4	4.4	9.36
1/100	2	2.7	4.68
1/200	1	1.35	2.34
1/400	0.5	.0675	1.17
1/500	—	0.54	0.936
1/1000	—	—	0.468

CURVED WEDGE is produced by a focal-plane shutter because it exposes the line progressively. To measure the wedge's total angle, draw lines from a ruler to indicate the points where the shutter opens and closes.





Put a tester in your screwdriver

By RAY SHOBERG

LIKE HAVING A COMB on the end of a brush, a continuity tester in the handle of a screwdriver is a natural when it comes to electrical troubleshooting.

A continuity tester consists of a battery and a bulb arranged in series with a pair of test leads. Any device placed in series across these leads, which completes the circuit, will light the bulb. Conversely, if the circuit being tested is "open" or incomplete, the bulb will not light. Suppose, for example, you have a fuse that is questionable. Connect it across the tester. If the bulb lights, the fuse is good.

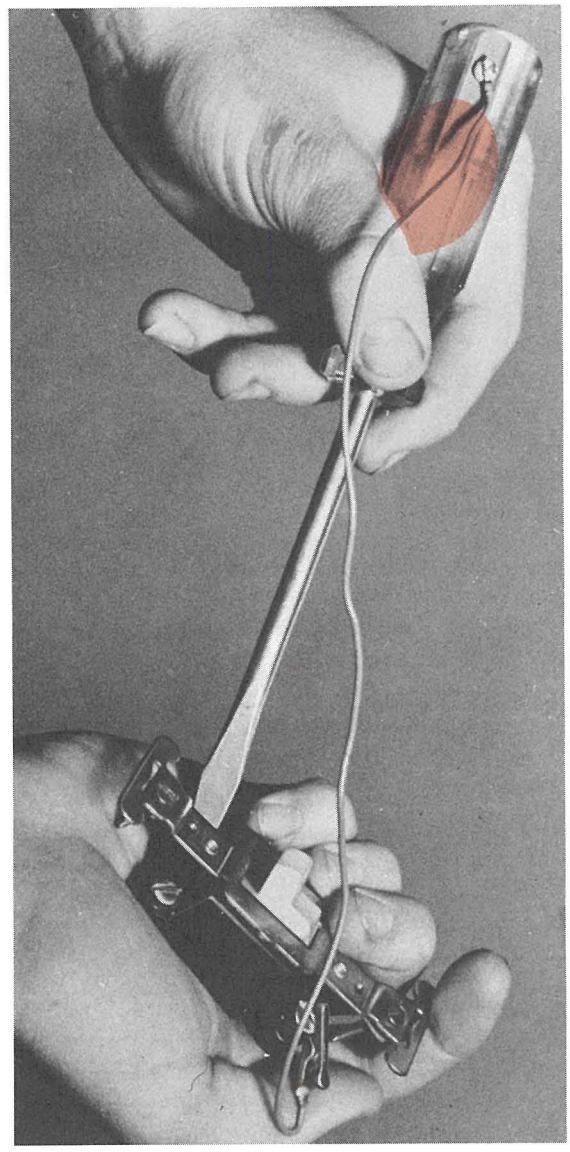
In addition to fuses you can trace circuit continuity of motors, coils, switches and other devices. You can also check for grounded circuits or apparatus by inserting the tester between the suspected terminals and "ground"; in most cases this is the metal frame. Always be sure, however, that the circuit being tested is disconnected from any external power.

To make such a two-in-one tool, pick a screwdriver that has a clear plastic handle. Since you will be drilling a 5/8-in. hole, buy one that has a 1¼-in.-dia. handle. Also select one that has a minimum of 2½ in. between the end of the embedded shank and the end of the handle.

The handle is counterbored with three different-sized drills, starting with a 5/8-in. bit, then a 3/8-in. one and finally a 1/16-in. drill. As the detail shows, the 5/8-in. hole is made deep enough to hold two mercury hearing-aid cells and a plastic plug. The 3/8-in. hole is for a spring and a bulb from a two-cell penlight, while the 1/16-in. hole is for a wire which makes electrical contact with the shank. Where a regular tester has two test leads, this combination screwdriver-tester makes use of the blade for one lead. The deep 1/16-in. hole is drilled in the soft plastic with a homemade drill made from a piece of wire. Two

SEE ALSO

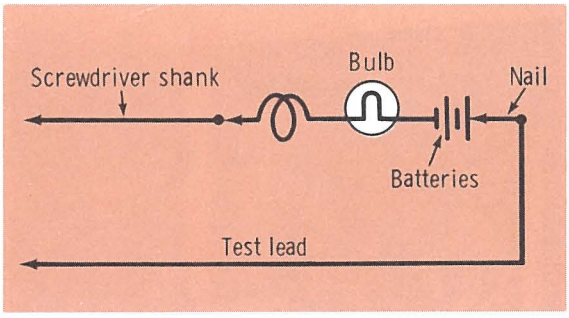
Doorbells . . . Electrical wiring . . . Pulse checkers . . . Wiring, electrical



sides are filed flat for a distance from the end and then sharpened like the end of a conventional metal-cutting drill. This will do the trick but you'll have to back it out often in order to keep the hole cleared of chips.

The spring is made of light wire (about .025-in.) and formed around a ¼-in. dowel so only the nose part of the bulb can enter. One end of the spring gets soldered to the shell of the bulb, while the other end is inserted into the 1/16-in. hole to make contact with the screwdriver shank. The batteries are inserted with the button of the first battery in contact with the bulb. Here you should have about 1/8 in. of extra space so that the end plug, when pressed in place, will push the batteries and bulb against the spring.

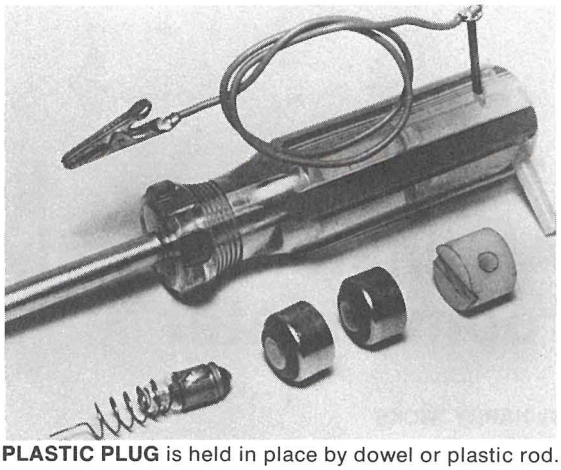
Next a 3/16-in. hole is drilled crosswise through the plug and handle for a plastic rod or



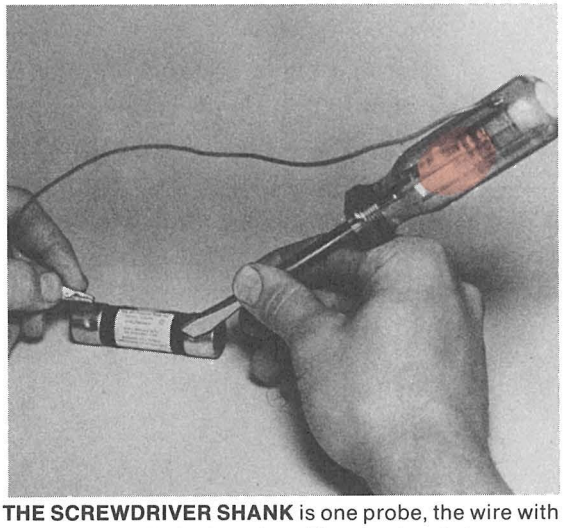
wooden dowel. The purpose of the plug is to make certain that, should the screwdriver contact a live electrical circuit during use, the voltage potential available through the spring, bulb and batteries will not come in direct contact with the hand. A rubber crutch tip pressed over the end of the handle will provide additional insulation and safety.

At the point where the plug contacts the batteries, drill a ⅛-in. hole for the test-lead tip which is a 7d box nail. Since the hole becomes more of a V-groove across the end of the plug, you'll do best to remove the plug and form the groove with a small round file. A length of stranded wire (18 or 20-ga.) is soldered to the cutoff nail and to an alligator clip. When inserted, the pointed nail contacts the batteries, readying the tester for use.

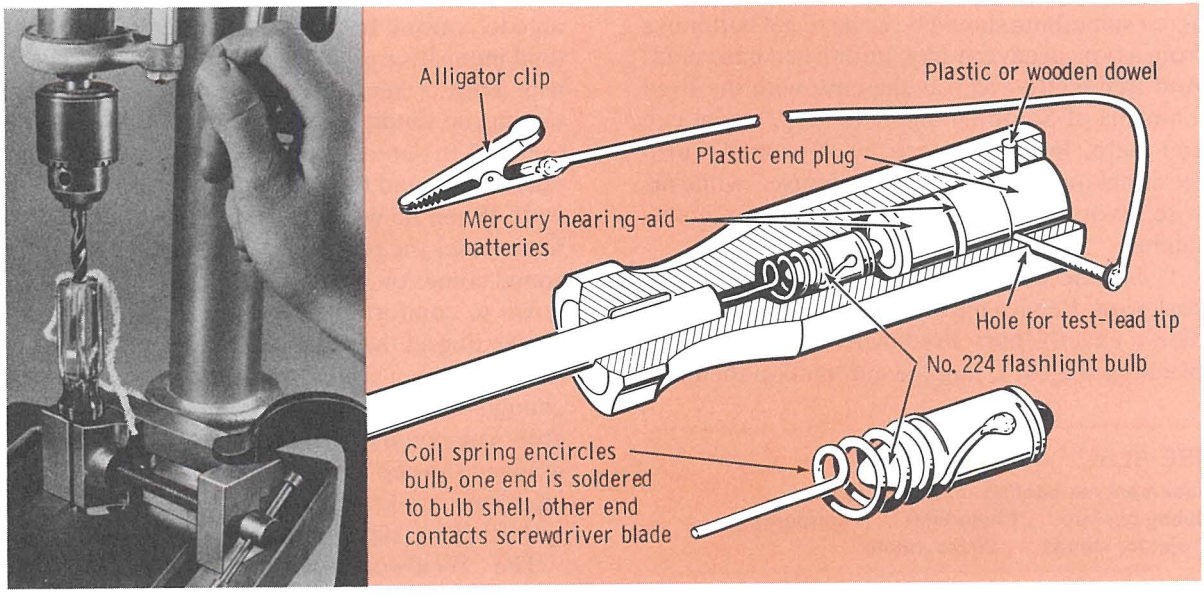
When it's not in use, keep the test tip out of the handle. This will conserve the batteries. With the test lead removed and the crutch tip in place, contact of the blade with high voltage will not damage either the bulb or batteries because the circuit is no longer complete.



PLASTIC PLUG is held in place by dowel or plastic rod. Slit in plug is a keyway for nail contact.



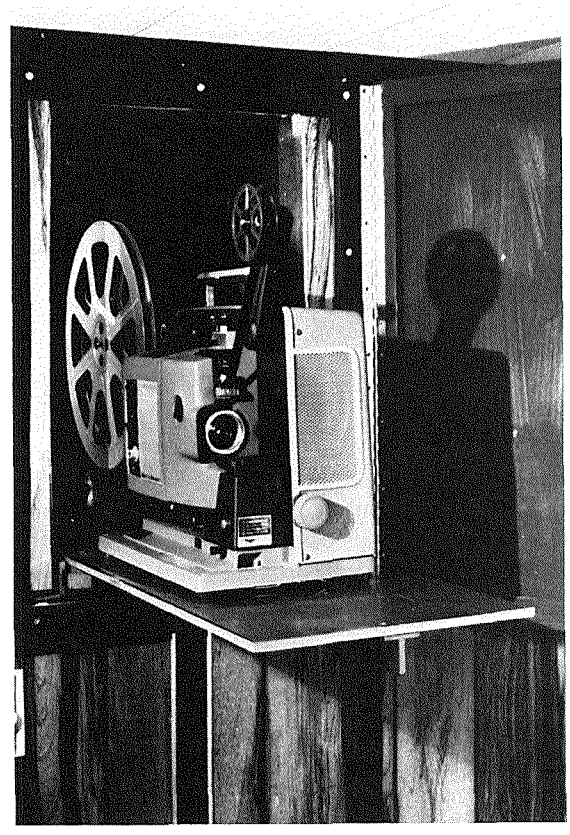
THE SCREWDRIVER SHANK is one probe, the wire with the alligator clip is the other. The glowing light means that the fuse being tested is good.


Alligator clip
Plastic or wooden dowel
Plastic end plug
Mercury hearing-aid batteries
Hole for test-lead tip
No. 224 flashlight bulb
Coil spring encircles bulb, one end is soldered to bulb shell, other end contacts screwdriver blade

An 'instant' family-room theater

By HARRY WICKS

Here's how to convert an unused basement into a combination family room and home movie theater. At the flick of pushbuttons, a hidden 5x10-foot screen comes into view, a projector rolls out of the wall, house lights dim and the show begins. When the movie's over, the special equipment vanishes and the room resumes its normal role



PROJECTOR rolls in, is hidden by door when not in use. Dimmer switch operates room lighting.

IT'S SAFE to assume most homeowners will agree something should be done to get better use from a typical cavern-like, unfinished basement. And frequently—as was the case with the Fred Entmans of South Orange, NJ—agreement can end there. In this instance, Fred wanted a professional-quality home "movie house" while his wife's vote was for a family room for entertaining.

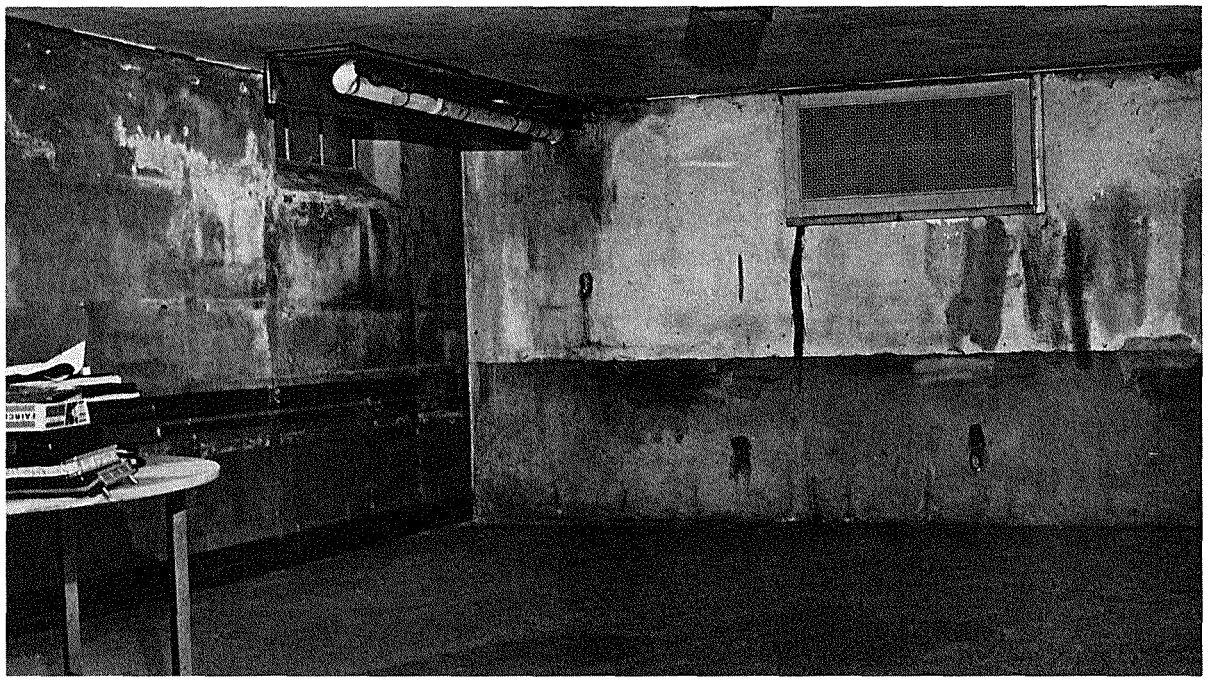
Using the design concept shown here, they *both* won. Being a partner in a new theater chain didn't exactly hurt Fred when he was in the planning stages. Using the automation theme of the theaters in the chain, he decided he would be able to conceal his movie equipment from sight (and inquisitive young hands) when it was not in use. Thus, when the room is needed for entertaining, he simply pushes a couple of buttons and the 5x10-ft. screen is concealed by vertical polyvinyl blinds and the projector rolls back into the wall. When he wants to show movies or slides, he reverses the procedure; the screen opens, the sound comes on, the house lights dim and he sits down to comfortable viewing.

Needing all the space he could get for a family room, Entman simply built out one wall deep enough to receive the projector. If you have the area, you could utilize the concept shown in the drawing to keep projector noise out of the viewing room and provide space for storage of film and other movie equipment.

The Weldwood Rosewood paneling was

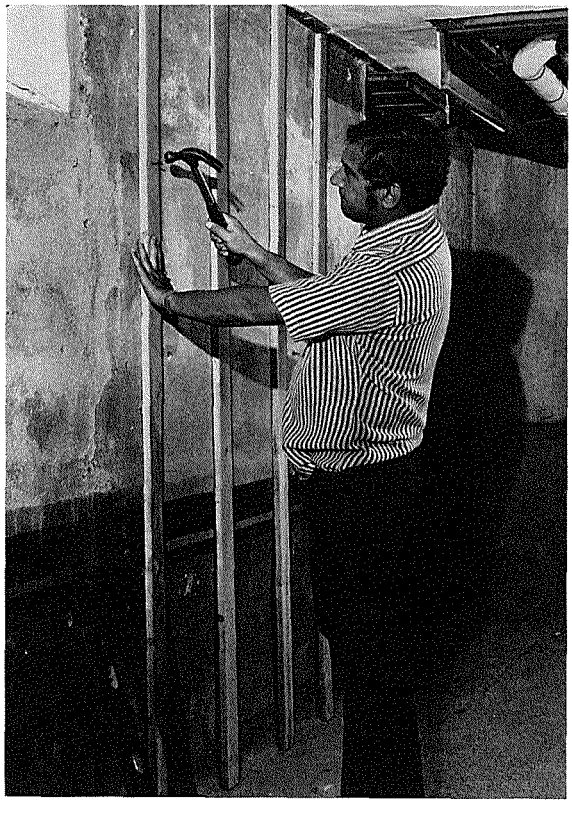
SEE ALSO
Basement remodeling . . . Family rooms . . . Hobby centers . . . Photo hints . . . Photography . . . Projector stands . . . Slides, photo

MINI THEATER (above) built in homeowner's basement, was inspired by the mechanisms of an automated movie house. For family-room use, a pool table becomes the fun center of the room (below).

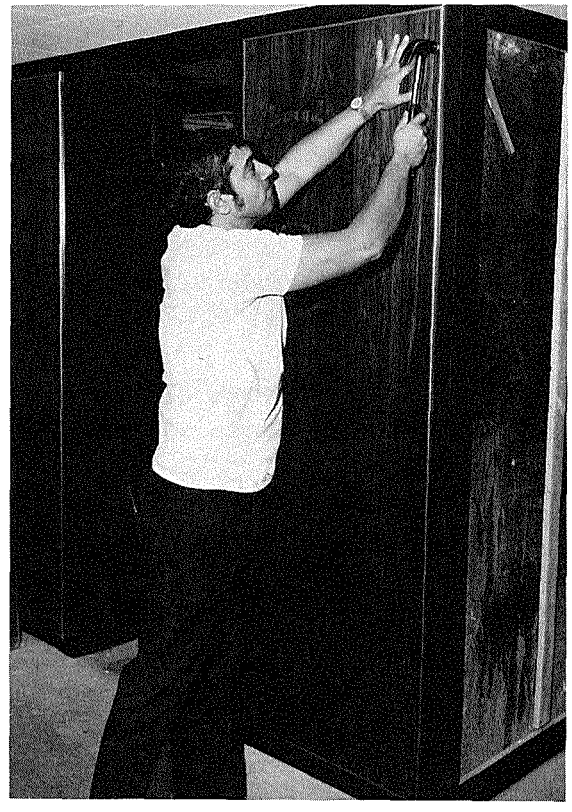


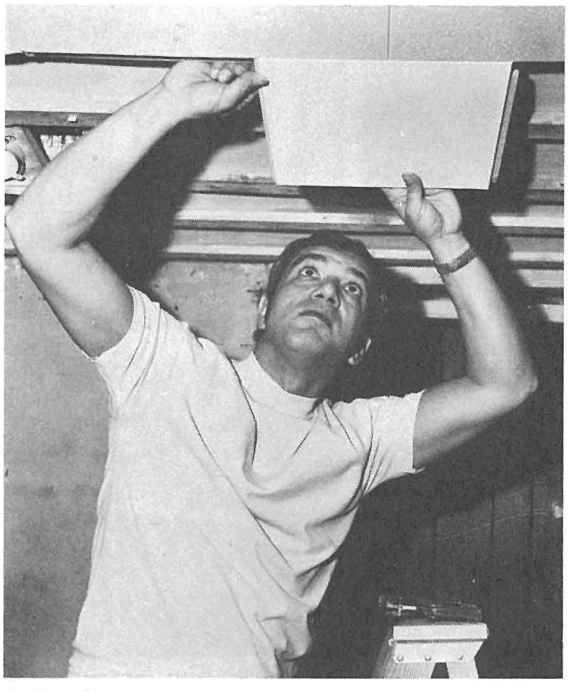
BEFORE: The typical basement wasted valuable floor space, was used only as a collection point for junk before it was discarded. Wall (above) is now covered by the projection screen shown on preceding two pages.

FURRING STRIPS were applied vertically, nailed to foundation wall and faced with decorative laminate.



ROSEWOOD PANELS were installed next using adhesive, brads, metal edge molding. Note black furring.



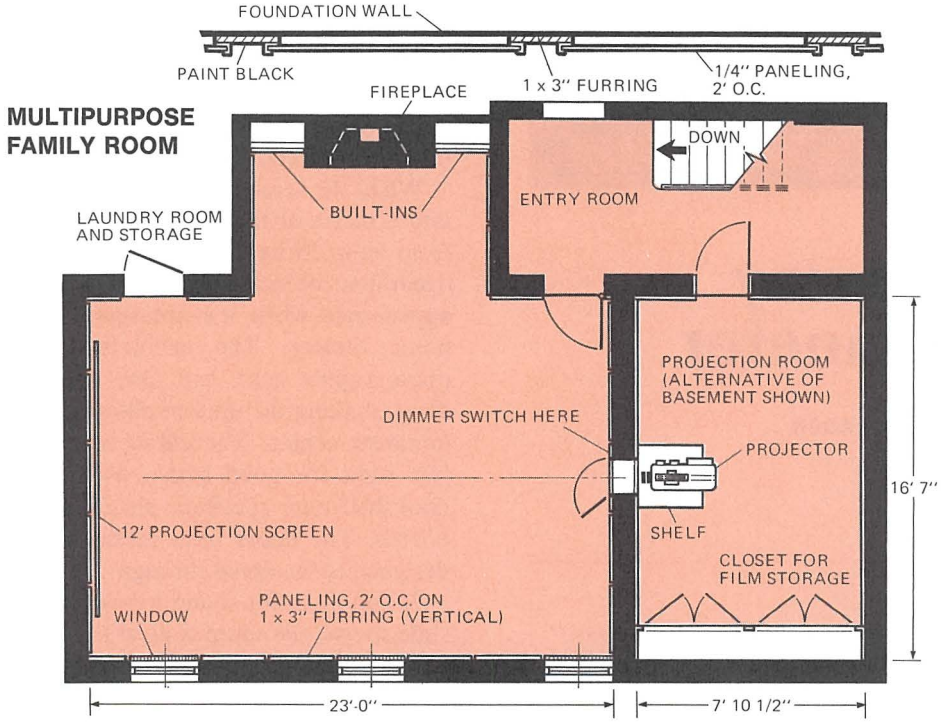


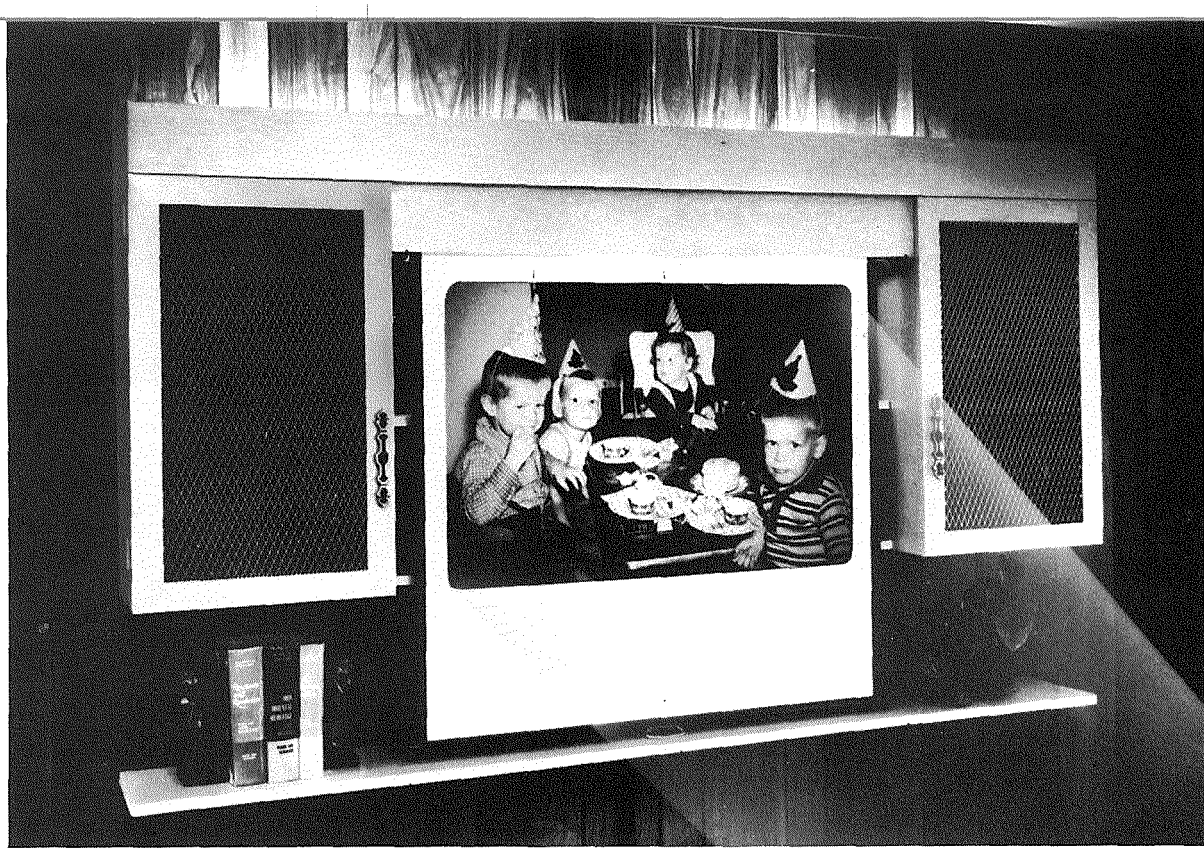
CEILING was furred using 1x3-in. stock. The finish ceiling is conventional 12-in. square tiles.

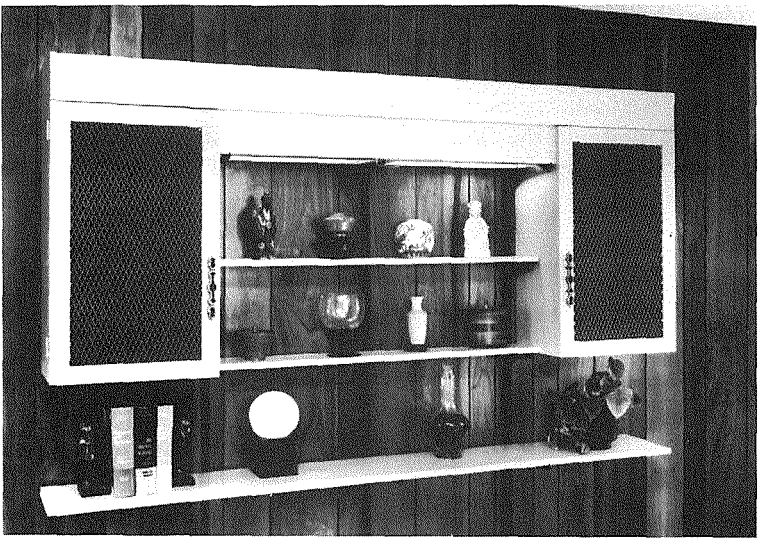
WALL-TO-WALL CARPETING adds touch of elegance. For practical reasons, carpet should be of washable type.

framed with anodized gold moldings and positioned on Formica-covered furring strips. (If you prefer, for economy, simply paint the furring with semigloss enamel.) To finish, flush high-hat lights were installed in the ceiling, then the ceiling was tiled and the floor carpeted. What was wasted space has been converted to "two" rooms in one.

FLOOR PLAN (below) shows an optional layout with projection room to hush projector noise and store film. If this takes too much space, simply move the wall back, allowing just enough space behind it to recess projector, as Entmans did.







WITH THE SCREEN RETRACTED (left), the unit looks like an ordinary wall cabinet with storage cupboards and knickknack shelves. Conversion to home theater (above) takes only seconds, makes showing slides or movies fun instead of a nuisance. The unit can be anchored to wall or suspended on shelf brackets.

A hideaway home theater

By SHELDON M. GALLAGER

BY THE TIME you haul out all the gear required to put on a slide or movie show, a lot of the fun has gone for you and your guests. This hideaway wall unit is designed to end the fuss and put the fun back into showing slides and movies. There's no screen to get out and set up because it's already built into the unit—you just pull it down and slip the projector out of one of the side cabinets.

When the screen is not in use, it disappears up into a recess at the top and is completely hidden from view. In its place are shelves for displaying decorative objects, giving the unit an attractive appearance when it's not serving as an instant home theater. The cabinets, besides storing photographic gear, can also house hi-fi equipment, making the unit an all-around home entertainment center. The cabinets are spaced apart just right for good stereo listening from small bookshelf-type speakers placed inside the cupboards. The doors have mesh-covered openings designed to let sound through.

If you go in for sound movies or sound-synced slide shows, the setup is ideal because the accompanying sound, filtering out through the mesh doors, will appear to come right from the projec-

SEE ALSO

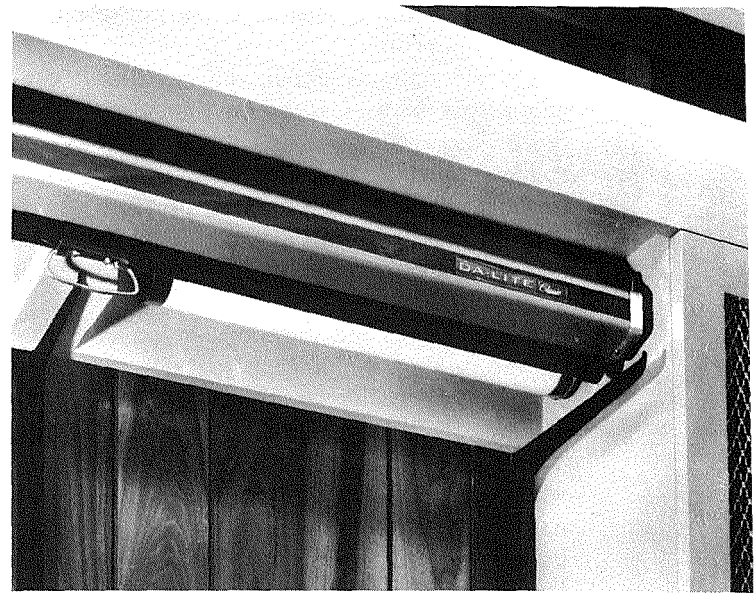
Family rooms . . . Hi-fi centers . . . Photography . . . Photo hints . . . Projector stands . . . Remodeling ideas . . . Stereo

tion screen. For added convenience, you can install one of NuTone's flush-mounting music/intercom systems, as shown in the photos below. These systems come in a variety of types and price ranges and offer a complete home communication center in a single, smartly styled unit with built-in radio, speaker and intercom controls.

The wall unit is built around a 40x40-inch pull-down screen made by Da-Lite. This type is designed expressly for wall or ceiling mounting and has brackets on the case that permit the screen to be hung from hooks or attached with screws. Such screens cost about the same as the regular floor-stand type.

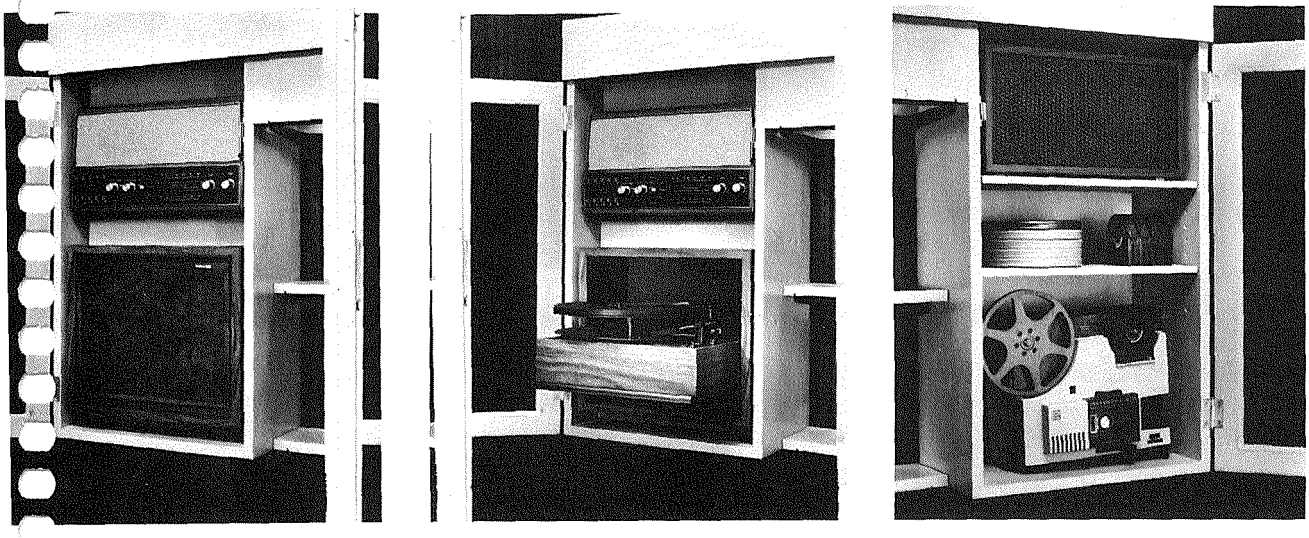
Dimensions of the unit can be altered as desired, but the 10-inch depth was chosen because it enables all parts except the back panels to be ripped from stock 1x12-inch lumber with little waste. The unit can be screwed directly to the wall, just as you would mount a kitchen cabinet, or it can be supported on metal shelf brackets of the type that hook into slotted wall standards. The 10-inch depth enables the unit to fit perfectly on standard 10-inch-long shelf brackets.

If you decide on wall brackets, one construction pointer is important. The unit should be supported on no fewer than *three* brackets—one at each end and one at the middle. The center bracket can't extend the full cabinet depth, however, or it would obviously block the screen from coming down. The answer here is to build up a small supporting framework at the center of the span just behind the screen. This framework is 6 inches deep and rests on a 6-inch shelf bracket, supporting the middle of the unit without interfering with the operation of the screen. The knickknack shelves also rest on 6-inch brackets,



UNDERSIDE VIEW with fascia board removed shows how the screen mounts at top of the unit between cabinets. With fascia board in place, the screen is hidden from view. Screen shown here is a 40 x 40-inch model made by Da-Lite. Two-way end brackets permit it to be hung from hooks or attached with screws.

HANGING SIDE CABINETS can house various pieces of equipment depending on your needs. Here, one is fitted with NuTone's in-a-wall music/intercom system designed to mount in shallow spaces. Upper unit (left, below) is AM/FM radio with 10-station intercom. Lower unit is fold-up record changer that swings out horizontally for use (center). Opposite cabinet (right) holds a Kodak Super-8 movie projector, film reels and a Model AS-18 Heathkit speaker.

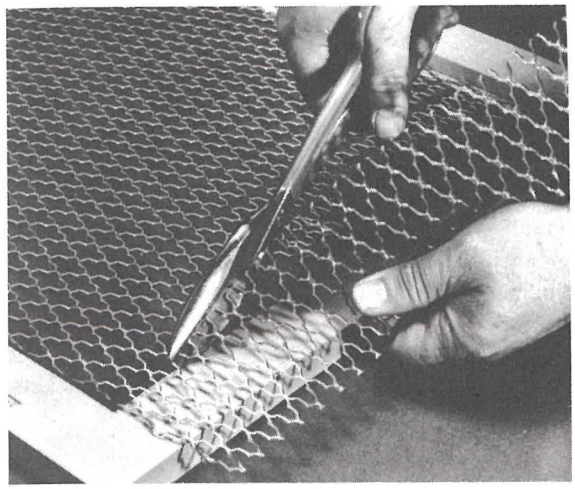


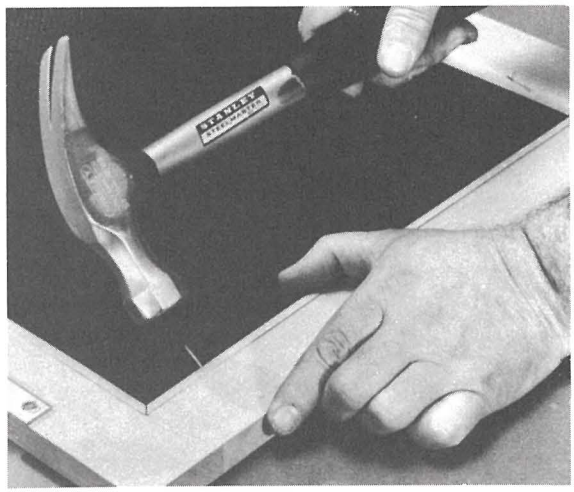
providing sufficient clearance for the screen to pull down in front.

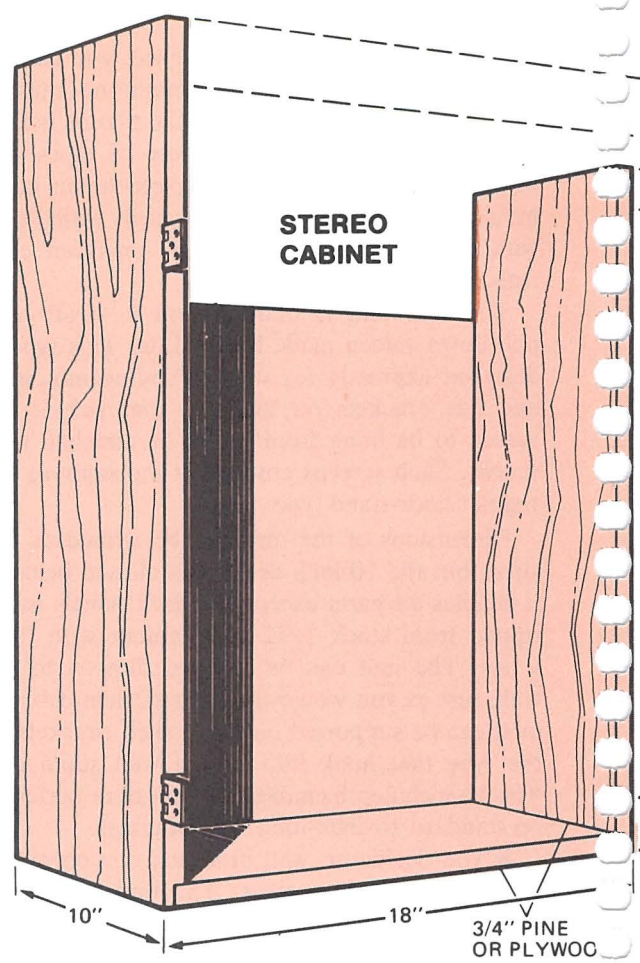
For maximum strength, the main strut running across the back at the top should extend the full 80-inch width—behind the cabinets as well as the screen—since it supports the entire weight of the unit where hung on shelf brackets. If you plan to mount the unit directly on the wall, you can, of course, eliminate the strut and center supporting framework.

Other options and variations are possible, too. As shown here, the unit incorporates a recess at the top for installing fluorescent lighting fixtures. These provide a soft, pleasing cove lighting effect. You can also build just the screen enclosure without the hanging side cabinets. Several alternate versions of this type are shown. Further information on screens can be obtained from Da-Lite Screen Co., Warsaw, Ind. 46580. For more details on Nu-Tone's in-a-wall music/intercom systems, write to NuTone Div., Madison and Red Bank Rds., Cincinnati, Ohio 45227.

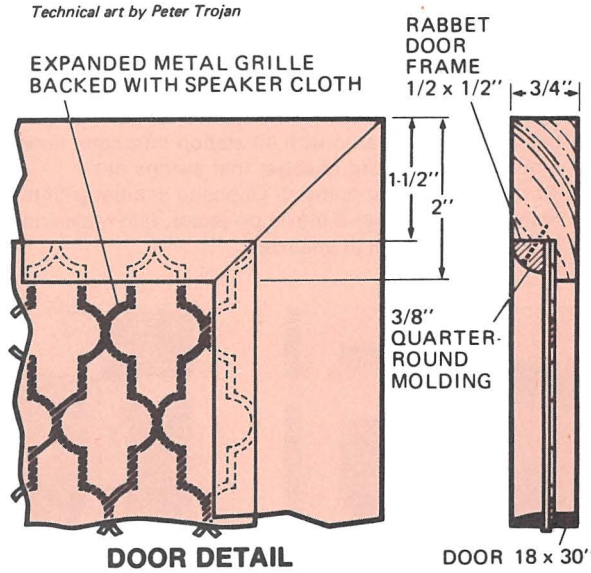
home theater, continued



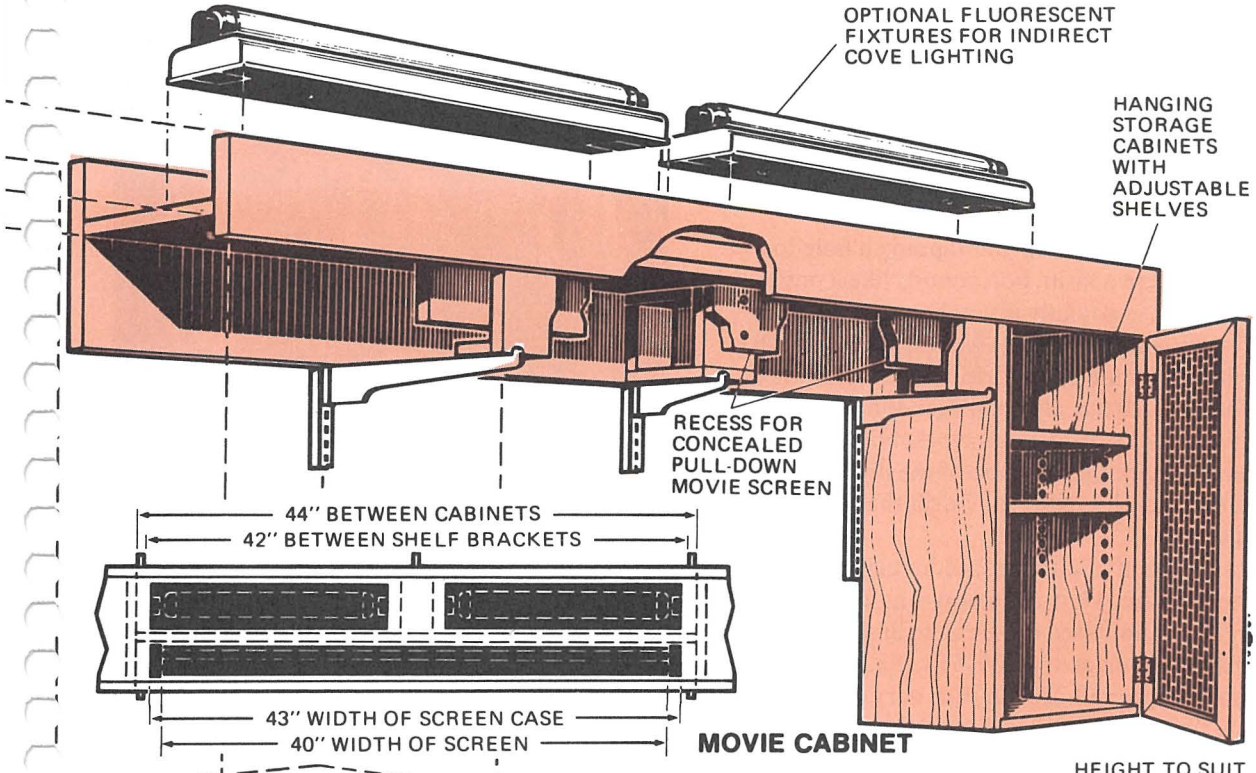




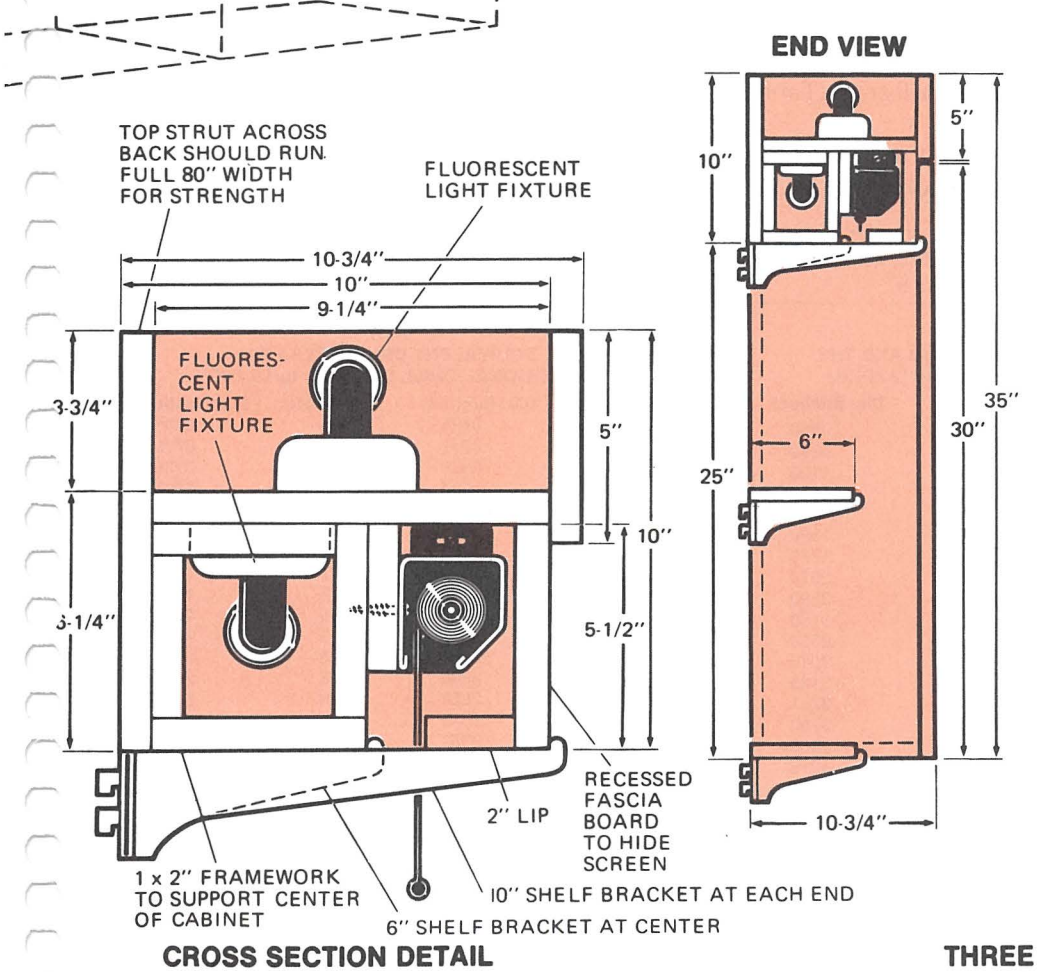
Technical art by Peter Trojan



GRILLE-COVERED OPENINGS in doors are designed to let sound through even when the doors are closed. Door rails are rabbeted to form recess on back side, then decorative Reynolds brass mesh is trimmed with tin snips to fit inside (top photo at left). The mesh is backed with black speaker cloth, and both are held in place with ⅜-inch quarter-round molding strips tacked in with small brads.

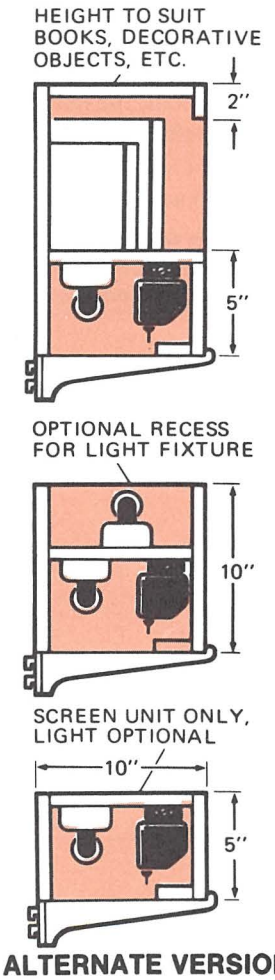

OPTIONAL FLUORESCENT FIXTURES FOR INDIRECT COVE LIGHTING
HANGING STORAGE CABINETS WITH ADJUSTABLE SHELVES
RECESS FOR CONCEALED PULL-DOWN MOVIE SCREEN
44" BETWEEN CABINETS
42" BETWEEN SHELF BRACKETS
43" WIDTH OF SCREEN CASE
40" WIDTH OF SCREEN

MOVIE CABINET



CROSS SECTION DETAIL THROUGH CENTER

END VIEW



THREE ALTERNATE VERSIONS WITHOUT HANGING CABINETS

Pick the right drill for the tap

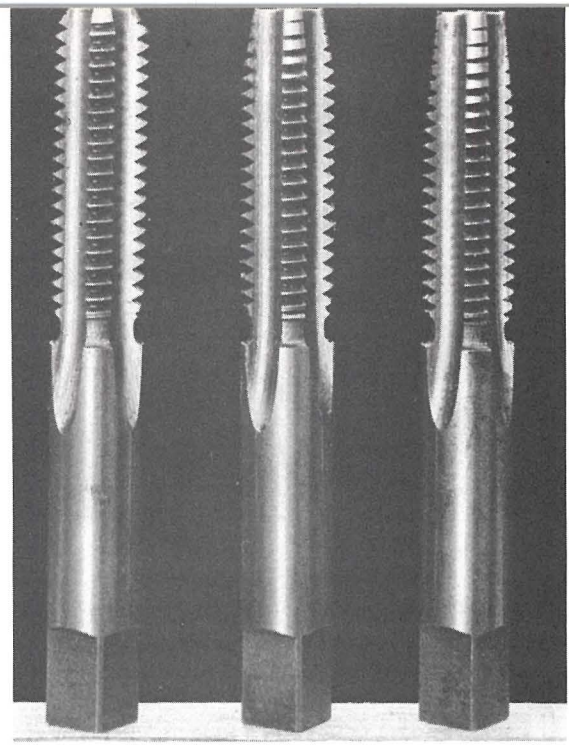
By ROBERT BRIGHTMAN

■ THE TASK of drilling and tapping a hole in a casting to accept a ¼-in. bolt sounds like a pretty routine chore, especially if you have a rackful of drills from 1/16 through ½ in. At first glance you'll figure it simply means a trip to the hardware store for a ¼ x 20 tap. But you're in for a surprise when you get back to your workshop. At this point you'll learn that not one of the drills in that well-stocked rack is the No. 7 drill that a ¼ x 20 tap requires.

More than half of all standard bolts in sizes up to ½ in. require what are known as numbered drills. These numbered drills range in size from a No. 80 drill that measures .0135 in. dia. to a No. 1 having a diameter of .2280 in. But very often, in a pinch, a fractional-size drill can be used.

Charts on this page give you that information. Thus, if you do not have a numbered drill, check the diameter of the recommended drill in Table A and consult the list of fractional drill sizes (Table B) for the nearest size.

For example, assume that you want to tap a hole to accept a 10 x 32 bolt. According to Table A this bolt requires a No. 21 drill—which measures .1590 in. in diameter. Then, if you refer to Table B you'll find that the nearest fractional drill is 5/32. This measures .1562 in. in dia., which is just close enough to do the job. However, inasmuch as this drill is slightly undersize, use care when tapping.



TYPES OF TAPS include (left to right) bottoming, plug and taper. To tap a blind hole, start with the taper, follow with plug and finish with bottom tap.

AMONG POPULAR BOLTS, note that more than half require a hole made with a numbered drill, while eight of the drill sizes are designated in fractions.

TABLE A

18 MOST COMMONLY USED BOLTS AND THE DRILL SIZES THEY REQUIRE FOR TAPPING

Bolt Size	Drill Size	Dia. (inches)
4x36	No. 44	.0860
4x40	No. 43	.0890
6x32	No. 35	.1100
8x32	No. 29	.1360
10x24	No. 25	.1495
10x32	No. 21	.1590
12x24	No. 16	.1770
¼x20	No. 7	.2010
¼x24	No. 4	.2090
¼x28	No. 3	.2130
5/16x18	17/64	.2656
5/16x24	9/32	.2812
⅜x16	5/16	.3125
⅜x24	21/64	.3281
7/16x14	⅜	.3750
7/16x20	25/64	.3906
½x13	27/64	.4219
½x20	29/64	.4531

EQUIVALENT DRILL sizes up to 7/32 in. are known by number, larger-size equivalents by letter. If you take a lettered drill, consult Table A.

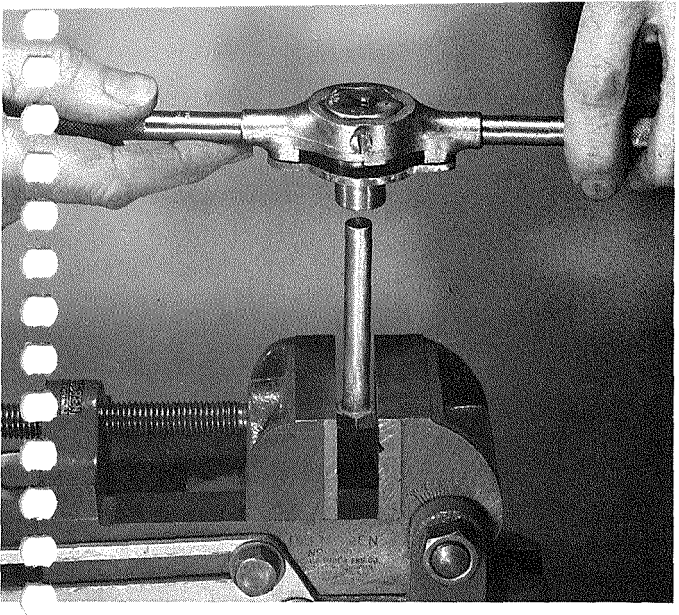
TABLE B

EQUIVALENT DRILL SIZES FOR FRACTIONAL DRILL SET—1/16 to 1/2-INCH

Fraction	Dia. (Inches)	No. Size	Dia. (Inches)
1/16	.0625	52	.0635
5/64	.0781	47	.0785
3/32	.0937	42	.0935
7/64	.1094	35	.1100
1/8	.1250	30	.1285
9/64	.1406	28	.1405
5/32	.1562	22	.1570
11/64	.1719	17	.1730
3/16	.1875	12	.1890
13/64	.2031	6	.2040
7/32	.2187	2	.2210
15/64	.2344	A	.2340
1/4	.2500	E	.2500
17/64	.2656	H	.2660
9/32	.2812	K	.2810
19/64	.2969	M	.2950
5/16	.3125	N	.3020
21/64	.3281	Q	.3320
11/32	.3437	S	.3480
23/64	.3594	T	.3580
3/8	.3750	V	.3770
25/64	.3906	W	.3860
13/32	.4062	Y	.4040
27/64	.4219		
7/16	.4375		
29/64	.4531		
15/32	.4687		
31/64	.4844		
1/2	.5000		

SEE ALSO

Bolts . . . Fasteners . . . Screws . . . Tools, hand . . . Twist drills



Attachment makes threading easy

By JOHN MALLAK

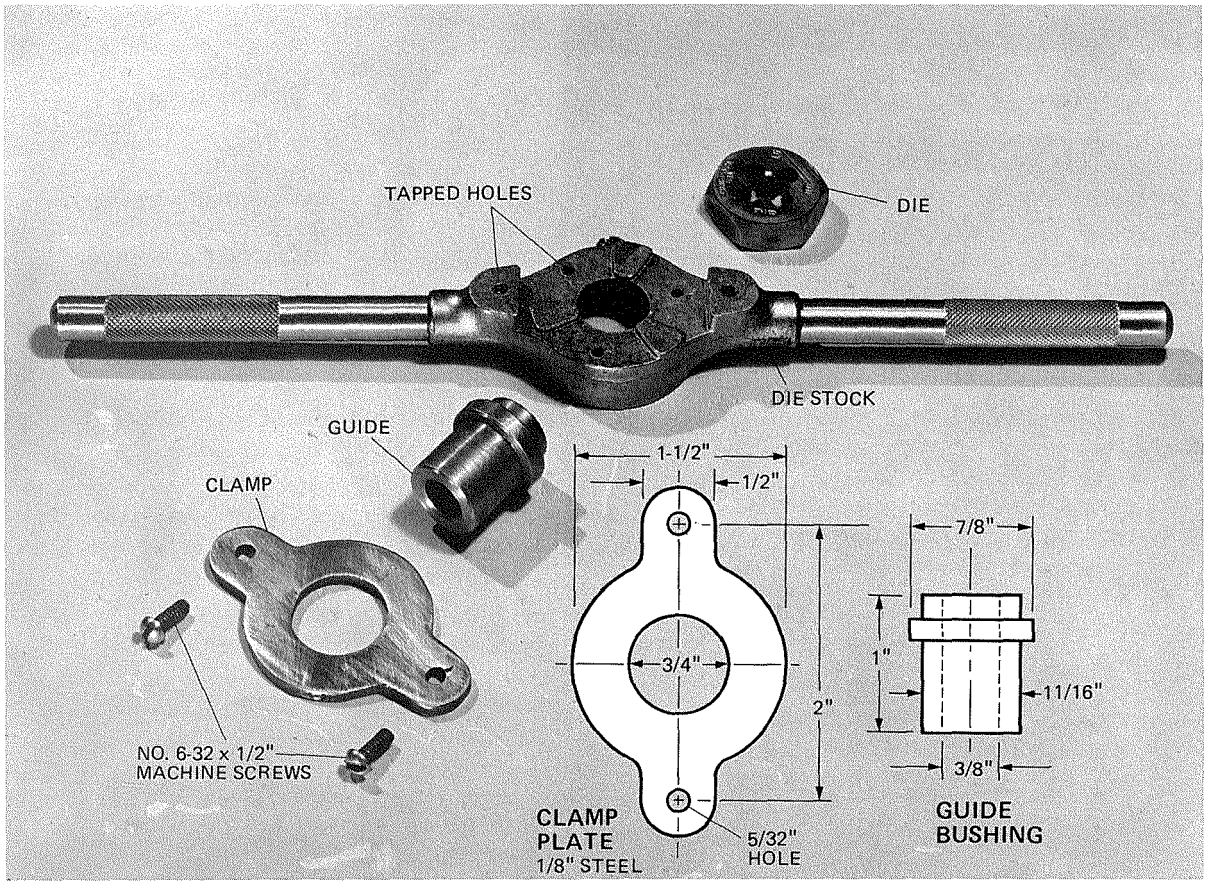
This attachment for your die stock uses a guide bushing to help you align your die properly and get a straight start

ONCE THE DIE is started straight and true, there's no trick to cutting uniform threads with a die stock, but I always had trouble aligning the die properly. If only the stock had a long bushing to align the die with the work automatically when slipped over the end. I solved my problem by making the attachment you see here to fit my Craftsman die stock. It has a clamp plate used to hold separate interchangeable guide bushings made to suit different diameters. Overall size of each bushing is identical; the hole through it is bored .010 in. oversize for an easy slip-on fit. The shoulder is made to fit the recess in the stock.

In use, back the die stock off often to clear chips. When threading very short rod, if the bushing interferes with and restricts the travel of the die, the bushing is easy to remove.

SEE ALSO

Bolts . . . Fasteners . . . Screws . . . Tools, hand . . . Twist drills



Tiling a floor is easier than ever

By WAYNE C. LECKEY

REMEMBER what a job it was to lay floor tile; how careful you had to be to spread just the right amount of adhesive or it would continue to ooze through the joints; how you got the stuff all over your hands? That's all changed now with floor tile that comes with adhesive already applied. You simply peel off the backing paper and press the tile in place.

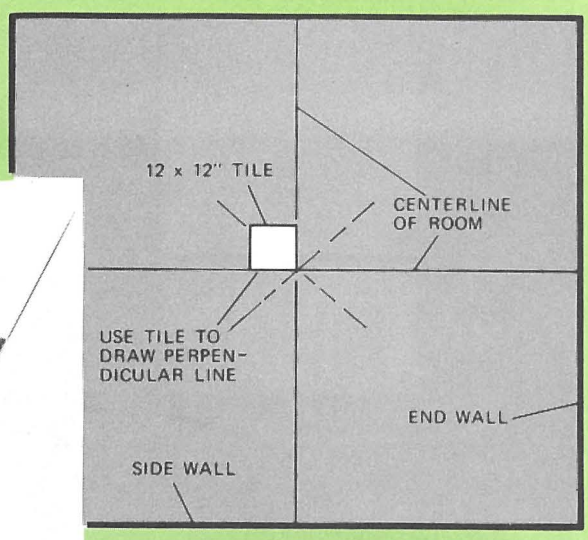
To see for ourselves we tiled a kitchen floor

SEE ALSO
Bathrooms . . . Floors . . . Kitchens . . . Tile, wall

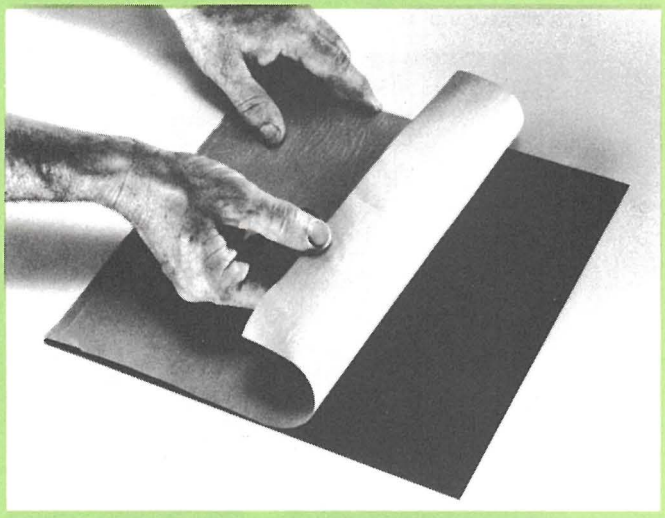
NOW TILING is an easy whiteglove job—any adult member of the family can do it. The tiles are 12 in. square and you can quickly cover a floor.

A BEAUTIFUL kitchen floor like this can be installed in a matter of hours. It is made of Armstrong's vinyl asbestos tile Excellon.

TO MARK A 90° line across the centerline of a room, an actual tile is used. As shown in the diagram at right, the tile is placed at the midpoint of the centerline, then a pencil line is drawn along the edge of the tile and the mark is extended to the side walls.



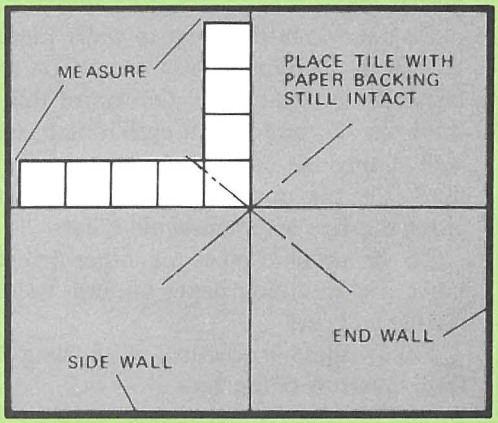
THE TILE has a slick paper backing, which you can peel off easily to expose the sticky bonding surface.

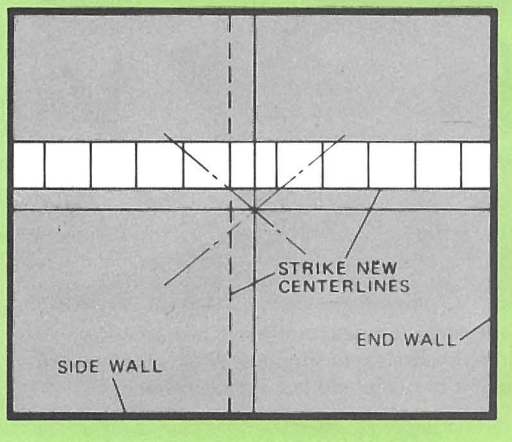


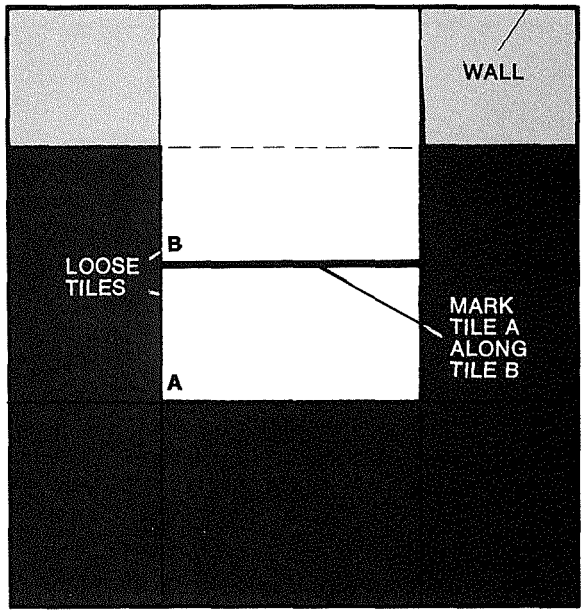
with Armstrong's Place'n Press Excellon (a vinyl asbestos tile) and I must say it beats the old way all hollow. It bonds instantly (no waiting for cement to dry) and *really* sticks. For this reason, we found you need to position it just where you want it the first time. You'll find this special pressure-sensitive adhesive will bond firmly to any smooth surface above or below grade. It can be applied right over existing floors.

We selected a pattern called San Roque. You

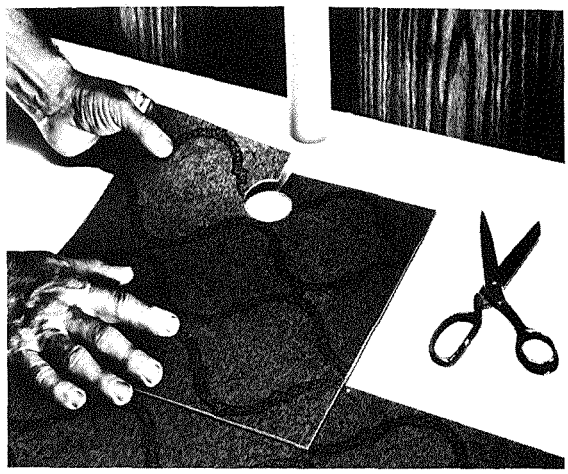
TO AVOID narrow border pieces (less than half a tile wide), check by placing a row of tiles along the 90° line as shown below. If less, strike a new line half the width of a tile away from the old line—toward or away from the side wall. Check the end wall the same way.







TO SCRIBE-FIT BORDER tile to wall, place tile A on top of the last full tile in the row (above). Then place tile B over A, butting it against the wall. Make a pencil mark along edge of B (below) to mark A for cut.



TO FIT TILE around pipes, or other odd-shaped obstructions, make a paper template. When satisfied with the fit, trace it onto tile and cut out with shears.

Prices vary, but, purchased in quantity, each tile costs about 50 cents. To cover a floor measuring 4 x 6 ft. you need 24 tiles; 9 x 12 ft., 108 tiles; etc. To cut it you use regular household shears. For the best installation, floors must be smooth and completely free of wax, grease and dirt. Dusty concrete subfloors should be vacuumed. Firm enamel paint and firmly bonded, smooth-surface (not embossed) linoleum or resilient-tile floors need not be removed.

keep tile warm

Tile should be kept warm—70° F.—for at least 24 hours before installation, during the job and for a week after to help establish a firm bond to the subfloor.

First, pry up molding at the base of the walls so tile can slide underneath during installation. Find the center for each end wall. Connect these points by striking a chalk line down the middle of the floor to establish a "center chalk line."

Next, locate the center of this line. Using an actual tile (paper backing intact) draw a perpendicular line. On this, strike a chalk line connecting the two sidewalls.

Place a row of tiles along the perpendicular chalk line from the center of the room to the sidewall (do not remove the backing). Measure the distance between the sidewall and the last full tile. If it is less than half the width of a tile, strike a new chalk line beside the old center chalk line half the width of a tile and toward or away from the wall. This will give even borders. Repeat this step for the end wall.

Start placing tiles at the center point where the chalk lines intersect, removing the backing paper from each tile as you install it. Make sure that edge tiles are even with the chalk line and each tile is butted tightly against adjoining tiles. Do not slide, but press them firmly into place.

Cover the first quarter of the floor, except the border area.

To cut and fit tiles next to walls, place a loose tile (A in diagram to left) exactly on top of the last full tile in any row. On top of this, place a third tile (B) and slide it until it butts against the wall. Using the edge of the top tile as a guide, mark the tile under it with a pencil; then cut along this line with household shears.

To fit around pipes or other irregularities, make a close-fitting paper pattern, trace this on the tile and cut.

Follow these procedures when tiling the other three-quarters of the floor.

What you should know about tiling walls

By LEN HILTS

You can put plastic, metal, ceramic, and even marble tiling on one or several walls in your home. Today's materials make the job easy

NO DOUBT ABOUT IT, tile adds the finishing touch to a house. It is both pleasing to the eye and practical in bathrooms, kitchens and even as a part of the decorative motif in living rooms. Add to that the fact that you can now tile any area yourself, and tile becomes an important material for the homeowner to know about.

Here are some of the ways you can use tile in your home to increase its livability and, incidentally, to increase its sale value:

1. *Bathrooms.* Tile the tub enclosure all the way to the ceiling. Tile the area above and back of the sink as a backsplash. Tile all the walls to chair-rail height, or tile the entire wall area. Tile the floor. Whether you do a lot or a little, new tile will make the bathroom easier to care for and better to look at,

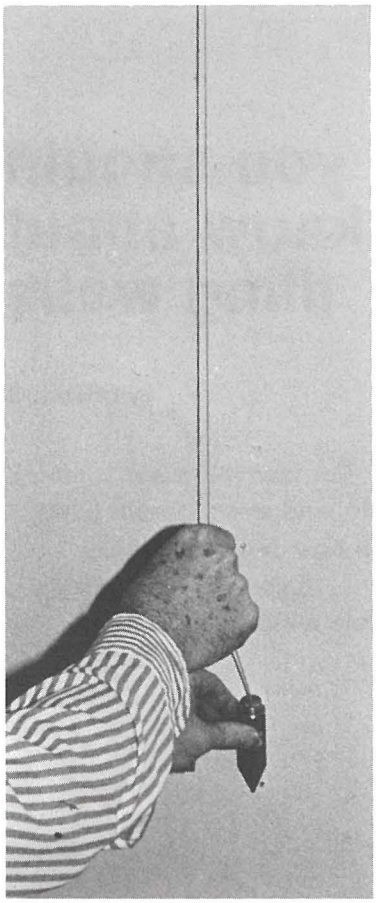
2. *Powder rooms.* As a rule, powder rooms (half baths) have less tiled area than bathrooms, with the majority of the wall area painted or wallpapered. However, if you choose, you can tile the whole thing, including the floor. At a minimum, you can install a tile backsplash for the sink.

3. *Laundry room.* Tile behind the laundry machines and the laundry sink can really add a touch of class to the usually plebian laundry room. If your laundry area is in the basement, tile on those gray concrete walls will dramatically elevate the appearance of the place.

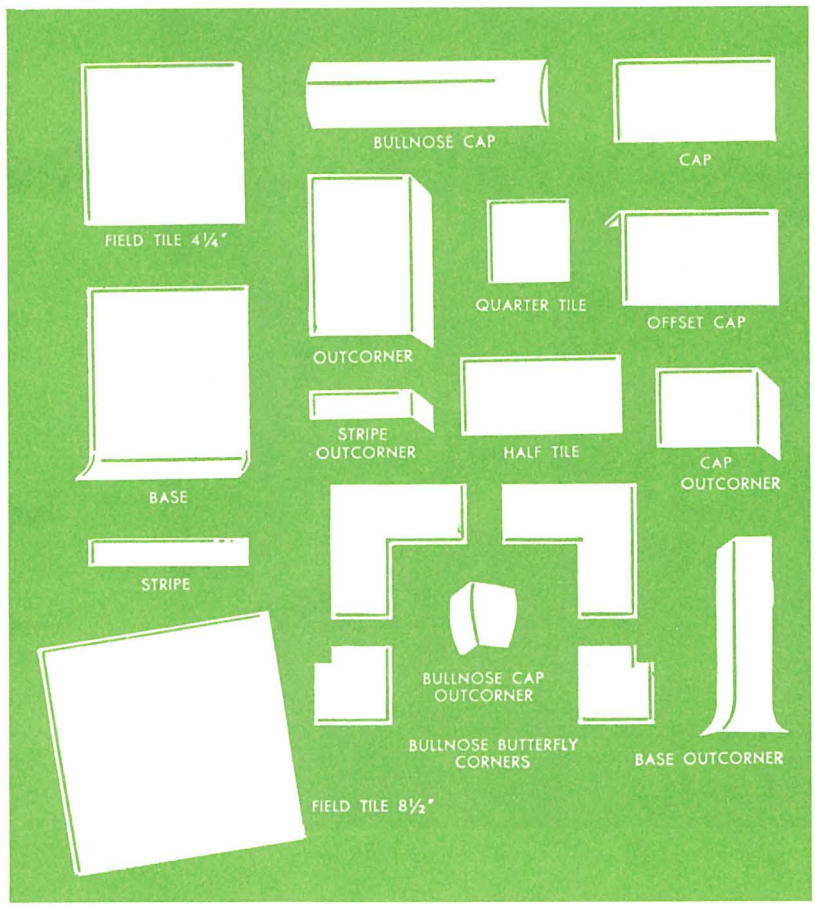
4. *Kitchen.* You can tile your counters here if you choose, but the usual use of tile in the kitchen is on the walls between the cabinet bottoms and the countertops, and as a backsplash for the sink. You can, of course, tile the floor but keep in mind that tile when wet can be slippery. Vinyl floor tiles with a nonslip surface would probably be more practical here than ceramic tiles.

5. *Living areas.* If you are looking for a way to create a distinctive living area, think about using tile, especially small mosaic tile, on one wall. There is a wide array of colors in a variety of shapes available, so you can really employ your imagination in designing this wall. Obviously, you can do too much tiling, too. Think about doing one wall or even a section of one wall. If

SEE ALSO
Bathrooms . . . Kitchens . . . Tile, floor . . . Wallpaper



DROP a chalked plumb line and snap it to make a vertical guide.



MATCHING ACCESSORIES are available with all types of tile. These include bases, caps, soap dishes, glass holders, towel bars and tissue holders.

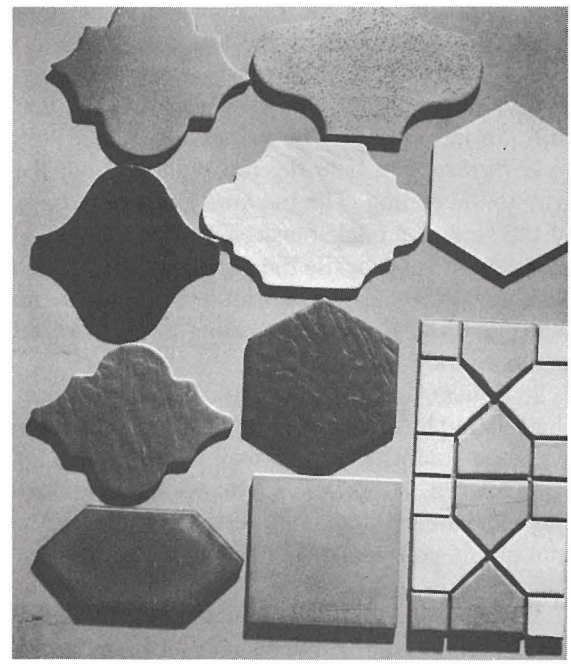
you have a fireplace that seems a bit humdrum, you might tile the wall above or around it for a new effect.

6. *Much-used areas.* Take a tip from the people who design public buildings if you have an area such as a long hall which is constantly in need of painting or washing because of fingerprints. You can cut the maintenance of such areas by tiling the lower, most-soiled portion. Don't use stark white bathroom tiles for this. Achieve a decorative effect by using colorful, small mosaic tiles.

types of tile

There are three basic types of wall tile—ceramic, metal and plastic. Plastic tile is considerably less expensive than ceramic tile, and is easier to install because cutting the plastic is easier than cutting the ceramic. But you pay a penalty because plastic tile tends to scratch easily in areas of heavy use. When scratched, it loses its luster. Also, some of the colored plastic fades with age. Metal tile is enameled, and its colors also tend to fade.

TILES ALSO COME in a variety of novelty shapes and sizes, including the small mosaic variety. You can use these for both walls and floors.



Ceramic tile, on the other hand, maintains its appearance under very heavy wear and does not fade. Its hard surface resists penetration of all types of dirt and grime. The surface of the grout between the tiles can get dirty and can become mildewed, however, so you need a regular cleaning program to keep the tile looking good.

Realtors tend to put a higher value on homes with ceramic tile baths, so keep this in mind as you make your decision. A larger expenditure now may mean a better price later.

The basic tile size is 4¼ x 4¼-in. Both plastic and ceramic tile are produced in this size. You can also find tiles up to 8½ x 8½-in. sq., but these usually are special-order items, while the standard sizes can now be purchased at most home center stores and from major mail-order houses.

In addition to the square field tiles, you can purchase a number of special shapes, including several different shapes of base and cap pieces. See the accompanying illustration. When planning your tiling job, make a list of the number of field tiles and of special shapes you will need. In addition to the shapes shown, you can also buy tile towel bars, toilet tissue holders, and soap dishes, all of which attach directly to the wall with tile mastic.

Tiles in decorative shapes have become available, too. With these, you can get away from the "standard" tile look and create exceptionally attractive tiled areas. Lozenge shapes, for example, provide a very Spanish look. These unusual tiles are no more difficult to install than the square units.

You can also buy small tiles, down to as small as half an inch square. These smaller tiles, called mosaics, come in square-foot sheets, with the tiles cemented to a mesh backing. Thus, you don't have to lay each tiny tile individually, but can put the tile up a square foot at a time. You'll find these mosaic tiles available in many colors, in sheets with multicolors on them, and even sheets with special designs already created.

If you are thinking about tiling any area in your home, the best way to start is to visit a couple of local home centers to see which types are readily available. Just looking at the tile displays will give you some ideas on how to use these fine home additions.

the mastic

Tiles are glued in place with a special mastic which you buy in large cans. The mastic is applied to the wall with a toothed spreader which leaves tiny ridges of mastic of just the right height. This prevents you from putting too much mastic on, and makes for a neat final job. If you apply too much mastic it will squeeze out between the tiles and mar the new surface.

Modern square tiles have another built-in solution to an old problem. Each tile has small spacers on all four edges. Thus, when you put the tile in place on the wall, you butt it up against its neighbor without worrying about how much space to leave between the two. The spacers on the tiles automatically provide the correct spacing.

cutting tile to fit

Many people have shied away from putting up their own tile, especially ceramic tile, because they have heard that cutting and trimming tile is difficult—a job for a professional. This isn't true. Cutting tile is similar to, but easier than, cutting glass.

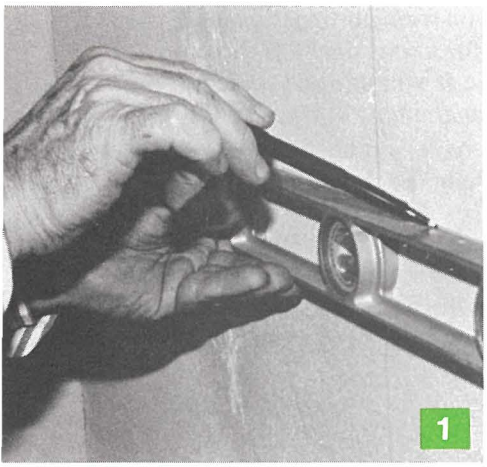
Plastic tile is easy to cut with a coping saw or sharp knife of the wallboard type. To cut a piece of tile to fit around a pipe, for example, all you need do is draw or trace the cutout on the surface of the tile, then lay the tile on a wooden cutting surface (a piece of 1 x 10 lumber is fine), and follow the drawn line with the knife or saw. You can make good, smooth cuts this way.

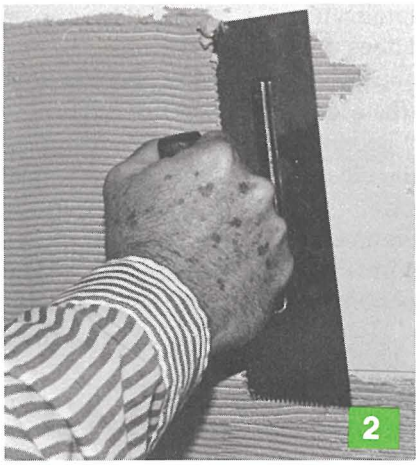
Cutting ceramic tile is more difficult. To make straight cuts—for example, to cut a field tile in half—you place the tile in a tile cutter (which a majority of stores that sell ceramic tile will either loan or rent to you), draw the stylus of the cutter across the tile at the point where you want the cut. You then tap the tile along the line drawn by the stylus, and it breaks cleanly. To finish the cut, you smooth it by sanding the raw edge a little with an emery cloth.

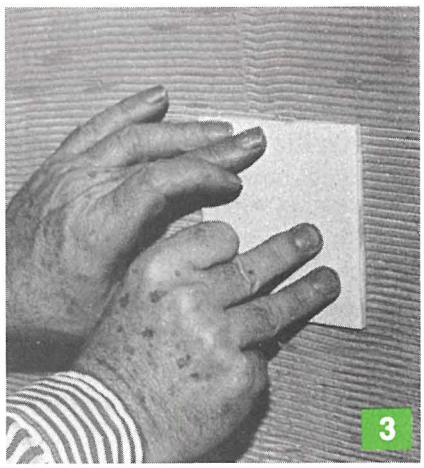
Other cuts—curved, for example—can be made by using an ordinary glass cutter instead of the tile cutter. You can also make some types of cuts with a tile nibbler, which is a type of pliers with cutting edges on its jaws. To use a nibbler, you make a series of tiny nibbles, beginning at one edge, cutting away a small portion of tile with each nibble. You continue cutting until you have formed the cutout shape needed.

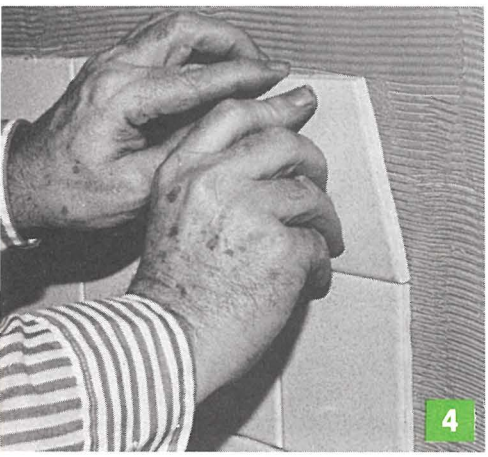
If you have a jigsaw, you can also use it to make cutouts in both plastic and ceramic tile. Use a fine-toothed blade of the type used to cut metal for this work. When making such cuts, be sure to wear safety glasses to protect your eyes.

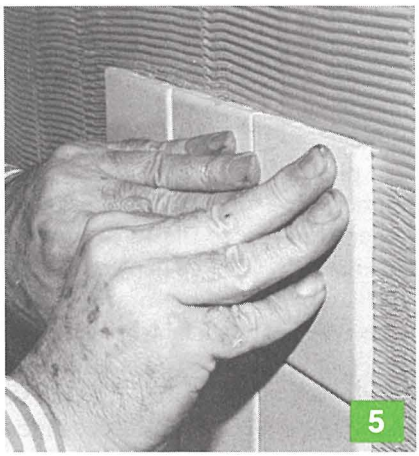
The easiest way to plan a tile job is to make a sketch of the area or areas to be tiled on graph paper. Make the sketch in scale, with four









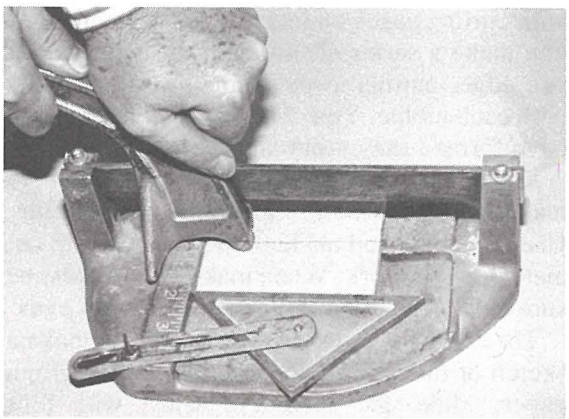


USE A SPIRIT level to make a horizontal guide line, then apply the tile mastic with a toothed trowel. Press hard on the trowel and spread the mastic thinly and evenly. Position the first tile at the intersection of the vertical and horizontal guide lines, which you should be able to see through the coat of mastic. Apply the second tile next to the first, snapping it into place. Slide it carefully so that it butts against the first tile. Take care to see that the mastic doesn't ooze out between the tiles. Be sure to align the tiles while the mastic is still pliable.

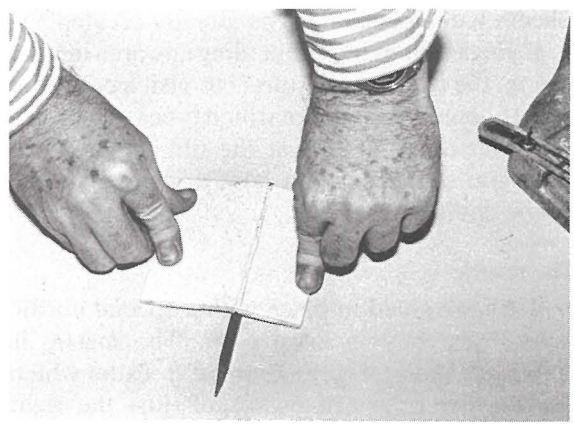
squares of the graph paper representing each square foot on the wall. Find out at your tile store what sizes the tile (and its accessory pieces) comes in. Then, working with these sizes, determine how many field tiles you'll need for the open areas of the wall, and how many accessory pieces, such as bases and caps, you'll need. If you plan carefully, you should be able to compute exactly how many tiles you'll need for the job, right there on the paper.

When you order the tile, it is a good idea to order somewhat more than the plan calls for. For one thing, if you haven't cut tile before, it is worthwhile to waste a couple of pieces in order

A RENTED TILE CUTTER is used to score a tile for cutting. You also can use a glass cutter.



THE SCORED TILE can be snapped easily by placing it on a pencil and applying pressure.



to practice cutting. You'll find you become proficient quite quickly—and it helps to know during this practice that it doesn't make any difference if you mess up a couple of cuts.

If you are using the small mosaic tile, you won't have to do much cutting. When you have to cut a larger tile, you'll find it easiest to do the job on tile cutter, a jigsaw, or with a coping saw. The nibbler, when used right, does a nice job on small tiles.

It is best to order all of the tile you need at one time. The reason is that the color may vary slightly from batch to batch. By getting it all at once, you are more likely to get tile in which there is no color variation. Usually you can get a refund on leftover tiles.

lining up the job

The first thing to remember when you begin to measure the wall for the tile is: no wall is ever true. Even walls which look perfectly square usually are not. For that reason, don't depend on the corner of the wall to provide a perfectly vertical line against which you can align your tiles. Instead, drop a plumb bob with a chalk line from the ceiling, and snap a vertical line on the wall. Use this line as your guide in placing the tiles.

Also, don't assume that the floor or the top of a bathtub is perfectly level. Use a good carpenter's level and draw a horizontal guide line across the vertical line drawn earlier. These two lines, if carefully made, will enable you to set your tile square.

In planning the layout of the tiles on the wall, you find that very often the last column of tiles, at the corner or edge of the wall, requires less than a full-width tile. The tile in this last column, for example, may be only 2 in. wide, so you must cut each tile to fit.

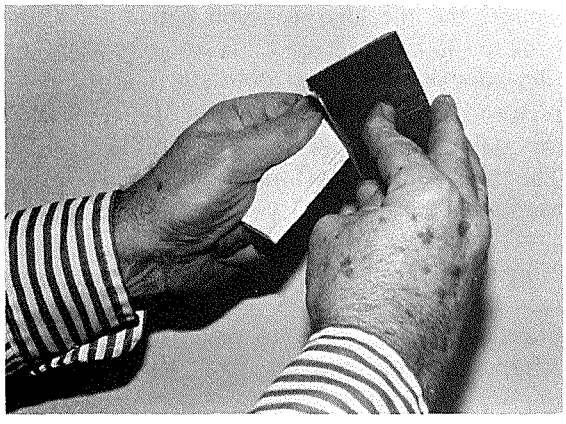
For the most professional looking job, however, center the tile pattern so that you don't have a full tile at the left side, for example, and 2-in. tiles at the right. Instead, cut 1 in. from the tiles at the left and 1 in. from the tiles at the right. While this means more cutting for you, it results in a better looking job.

The next step after establishing your horizontal and vertical guide lines is to put the mastic on the wall. Before you open the can of mastic, read the label; then follow the instructions exactly. You probably will be told to apply the mastic with a toothed applicator and cover 3 or 4 sq. ft. at a time. Then allow the mastic to set for 20 minutes before applying the tile. Do exactly what the label says. You'll get better results.

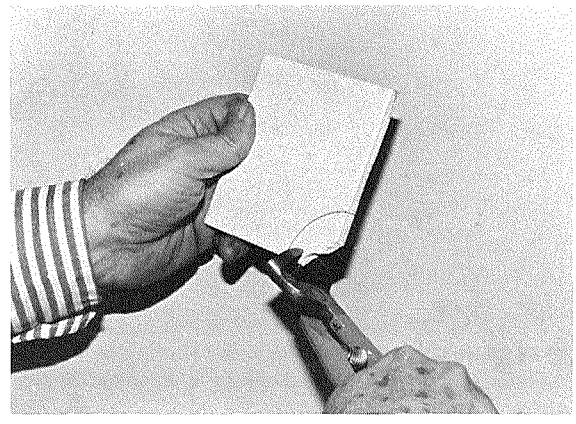
After the mastic has set the required time, press the first tile in place. Align it carefully with your guidelines, which you should be able to see through the mastic. Begin at the bottom of the area to be tiled, and at one corner. Lay in the entire bottom row, one tile after another.

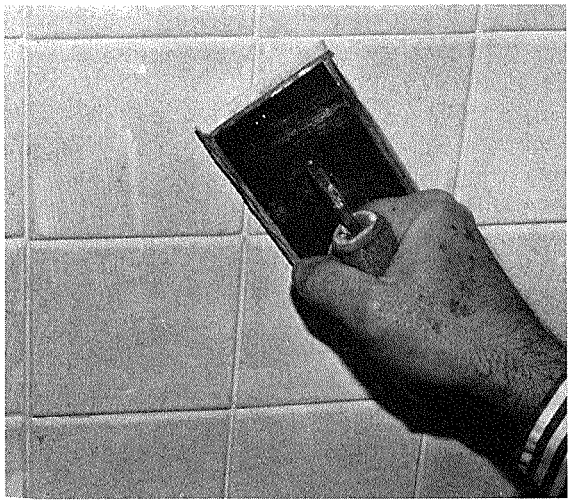
When placing a tile on the mastic, put the bottom edge into the mastic just touching the tile beneath it and very near the tile to its right. Then sort of "snap" the tile onto the wall. Now press it into its final position, sliding it against its neighbors and seating it firmly in the mastic. Do not slide the tile more than a small fraction of an inch or you may force mastic up between the tiles. However, be certain that each tile is butted firmly against its neighbors, and that the tiles all appear straight and true. You can make adjustments now, while the mastic is still soft.

SAND THE EDGES of the cut tile smooth, using emery cloth or abrasive paper.



TILE NIPPERS are used to nibble away bits of the tile until you have cut to the mark.





MIX THE GROUT to a creamy paste and apply it to the wall after the mastic has set for at least 24 hours. A rubber-faced grout float is used.

YOU ALSO CAN USE a cellulose sponge instead of a grout float to apply the grout. Be sure to work grout into all of the grooves.

AFTER THE GROUT has set for about 10 minutes, use the rounded end of a toothbrush handle to scrape away any excess in each of the grooves.

When all the tiles have been laid, allow the mastic to set according to the instructions. Usually, you are told not to apply the grout for at least 24 hours.

Mix the grout by adding water to make a thick, creamy mixture. Apply this mixture to the spaces between the tiles, using either a small cellulose sponge or a grout float. Work the grout down into the grooves; keep checking as you work to see that there are no unfilled spaces.

As the grout begins to harden, use the rounded end of a toothbrush handle to scrape away excess grout in each groove. The handle provides the proper concave surface to smooth the grout in each groove. After the grout has set hard, brush the entire wall with a medium-stiff brush to clean away all excess grout. Finally, spray the new grout with a silicone sealer.

In addition to the tiles already described, you can now buy real marble tiles. Made in Italy, these tiles are 6 x 6-in. slabs of genuine marble, ¼-in. thick. They come in several colors and are applied in the same way as ceramic tiles. Decorators use them for window sills, backsplashes for sinks, decoration around fireplaces, fireplace aprons, and as countertops.

Marble may stain or scratch in use, but if it does, you can restore its original beauty by polishing it. You can buy marble cleaners which remove most stains. To apply a new polished surface to scratched marble, buff the marble, using a soft polishing pad in your electric drill. Apply a paste of fine abrasive material first, then polish until the scratches disappear. For an abrasive, you can use an automobile rubbing compound, or a creamy mixture of water and pumice or rottenstone. A fine abrasive provides the brightest polish.

tile repairs

If you ever have a cracked ceramic tile—which could happen if something heavy falls against the tile sharply—you can remove the broken tile and replace it. To remove a broken tile, use a sharp-pointed tool such as an awl or ice pick to dig out the grout around it. Then insert the tool into the grout's groove and pry upward. The tile should pop off the wall without disturbing its neighbors.

Next, scrape all of the old mastic off the wall. Now apply a thin coat of mastic to the back of a new tile, no more than $^1/_{16}$-in. thick. Finally, press the tile in place to make good contact. After the mastic has set for at least 24 hours, apply new grout.

How to repair a ceramic-tile wall

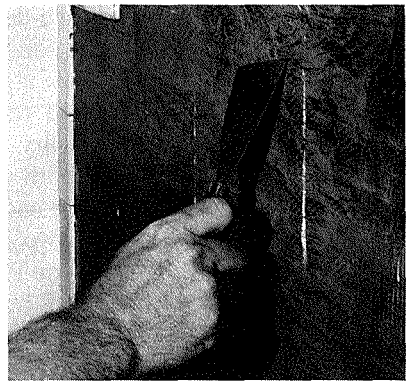
By VICTOR W. KONDRA

LOOSE TILES on a bathroom tub wall invite expensive-to-repair water damage to plasterboard behind tiles and to a ceiling below. Though time-consuming, tile repairs are inexpensive and very much within a do-it-yourselfer's skills. Remove the loose tiles, cleaning the wall surface and preparing it for re-application.

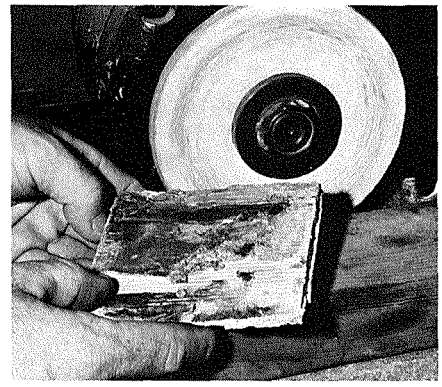
Grouting, a once-bothersome chore, is now greatly simplified: New acrylic latex grouts are easy to handle, but make certain you read the maker's instructions before using. After applying grout, let it dry thoroughly (overnight) before wiping tile with a dry turkish towel. To polish tile, use a quality glass cleaner.

USING FIST or a rubber mallet, tap all over to locate and remove loose tiles. Tap gently to avoid cracking the tiles.

REMOVE old adhesive by scraping with putty knife; if necessary, use compatible solvent to soften mastic.



REMOVE LARGE CHUNKS of grout from tile by hand, then grind off any remainder with a coarse grinding wheel.

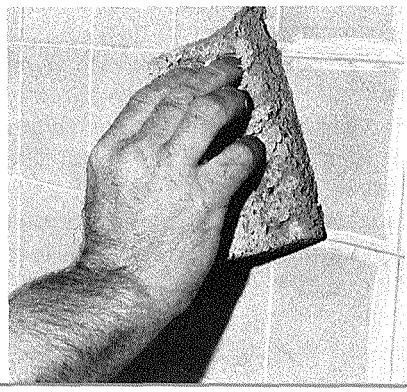


APPLY CERAMIC-TILE adhesive with a putty knife after making certain that wall surface is dry and sound.

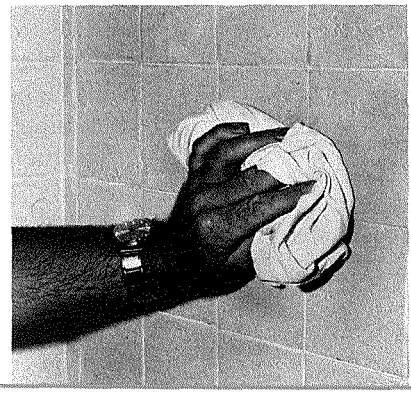
SPREAD ADHESIVE with a trowel and carefully press tiles in place. Author also put some adhesive on tile backs.

PRESS acrylic grout into joints with your fingers. Fill all cracks so grout is flush with face of the wall.

WIPE ENTIRE AREA with dampened sponge. Don't over-wet sponge or the grout will be washed out of the joints.



PERMIT GROUT to dry for the time period recommended by maker. Then remove film by polishing with a towel.

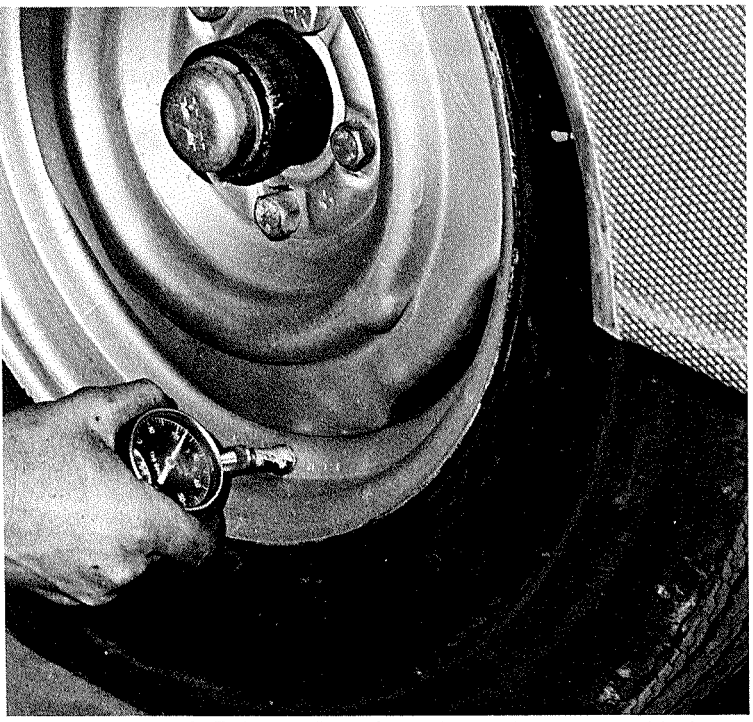


SEE ALSO

Bathrooms . . . Kitchens . . . Tile, floor . . . Wallpaper

How to take care of your tires

Tires can well be the automotive part most vital to your safety. Two ingredients are the most important to ensure their reliability and long life. And both these ingredients are yours without financial outlay



INFLATION PRESSURE is the single most critical characteristic of good tire care. For consistency, use your own gauge. For precision, you can apply a correction factor developed by comparing it with the master gauge at a major tire dealer's shop.

MEN IN THE TIRE industry have an aphorism they repeat regularly to illustrate their product's importance. "The brakes only stop the wheels," they say. "It's the tires that stop the car."

More than that, of course, the tires also start it. And turn it. Those four small contact patches where the tires meet the road—the footprints—are the only chance your car has for a grip on the road. That grip means everything.

Forget the rest. The gleaming finish, the strong suspension, the best tuned engine, and the race-designed steering system. None of it is much good if the tires fall down on their job.

In view of their importance, it might be startling to realize that only two ingredients are necessary to ensure reliable, long-lived tires. And both are free.

Care and air are the only things required. And of the two, neglecting air pressure is more costly.

If you're determined to keep tires properly inflated, however, you can't be sloppy about it.

You must know the right pressure. And you need to recognize it may be different in the front than in the rear.

Many people found Detroit's recommendations for the classic Corvair strange indeed. GM said the rears were to get about 60 per cent more air. The car had little front overhang, but the engine was sitting right over the rear axle—with much of its weight even *behind* the axle.

The manufacturer's recommendation is an important guide, then, to the pressure you need. But you might reasonably decide that it isn't the last word.

Increasingly, manufacturers themselves are suggesting you add about four pounds to the base recommendation for heavy loads or high speeds. Clearly, they don't feel that amounts to overinflation. Nor is it overinflation if you harden tires for a particularly heavy load. And merely a full load of passengers and luggage sometimes amounts to "particularly heavy."

You can't be as confident, however, about going far beyond that extra four pounds. Greatly overinflated tires put more weight in the center of the footprint than they put at the sides. The middle of the tread then wears faster.

In underinflated tires, the tread at the footprint tends to cup up in the middle as the sidewalls lose

SEE ALSO

Autos, repair . . . Brakes, auto . . . Steering and suspension, auto . . . Wheels, auto

stiffness. So the corollary also holds: The shoulders of underinflated tires carry more than their fair load—and wear faster.

Tread wear isn't the most serious result of underinflation. The sidewalls flex each time the wheel rotates—close to a thousand times each mile. Firmer tires flex less.

A heavier load calls for more air because of this same flexing. Added weight tends to crush sidewalls, so they need more internal support.

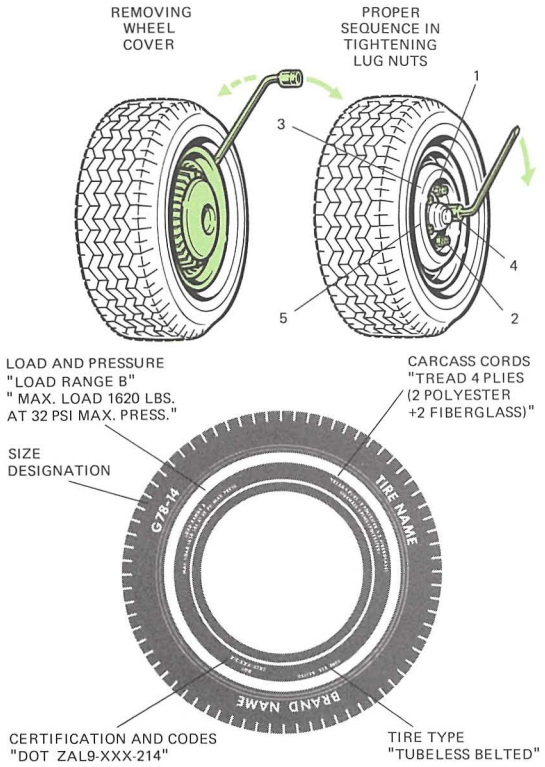
You get still another bonus from adding air. Firm tires have less rolling resistance so you get better fuel mileage. In an informal fuel economy competition some years ago, a Shell researcher went the limit in fighting rolling resistance: He literally filled his tires with concrete. (It didn't help. He couldn't find a way to keep the tires perfectly round while the concrete set.)

radials' advantage

Traditional bias-ply tires, by the way, suffer more from flexing; their sidewalls are stiffer, so they present more rolling resistance. That's because, as the flat footprint area effectively travels around the tread, the plies tend toward a scissors-like motion. But, molded into solid rubber, they're restrained from that motion.

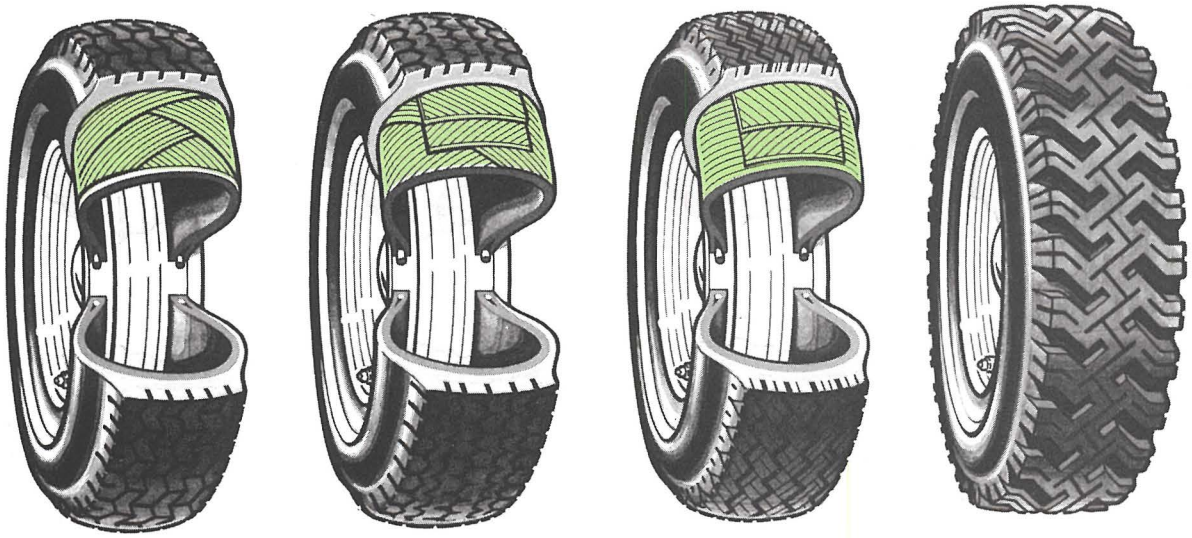
Radials, on the other hand, make no particular try for sidewall stiffness.

As tires warm up in running, and flexing, pressure naturally increases. That's allowed for in cold-tire pressure recommendations. So check the tires before you get under way—or at least before they've been run a mile at moderate speeds after sitting idle for at least three hours.

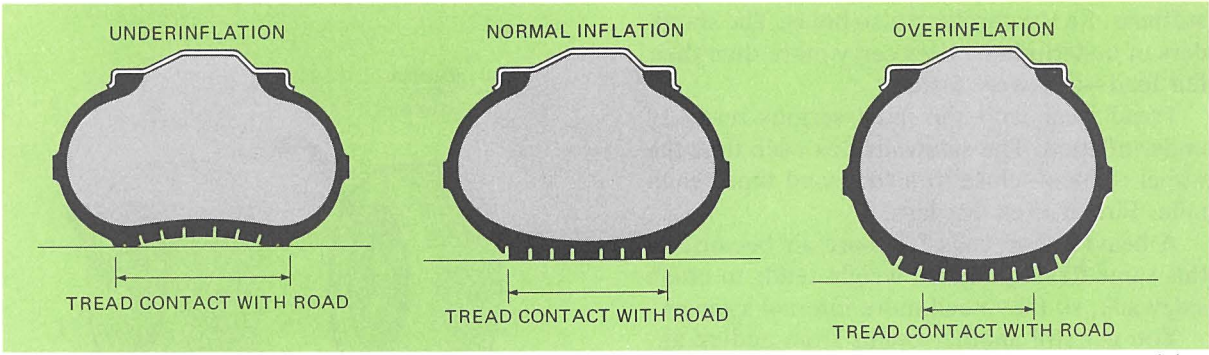


TIGHTEN LUG NUTS in proper sequence (top); manual pressure is enough. Information aplenty is on the sidewalls (above), but you have to interpret it.

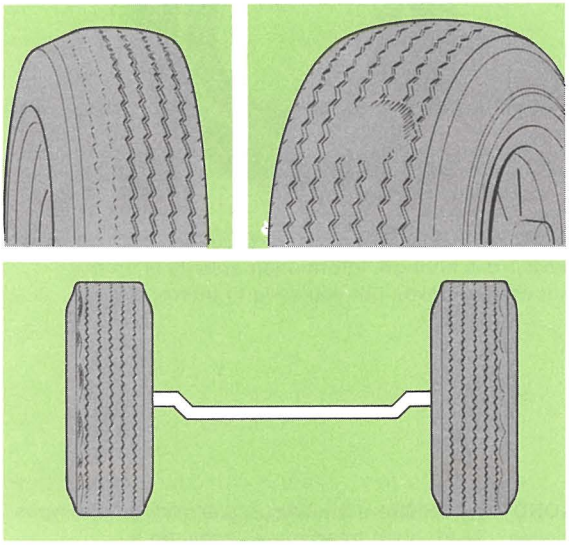
CORD PATTERNS are what distinguish modern tire types (below). Deep, open tread marks snow tires.



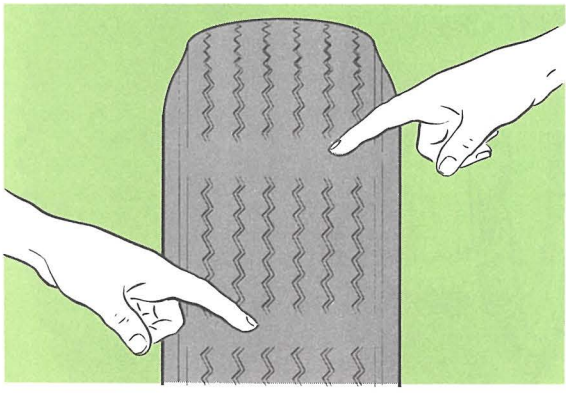
BIAS PLY | BELTED BIAS | RADIAL | SNOW



BOTH UNDERINFLATION and overinflation can bring uneven tire wear. That means extra wear in some places—and the probability of premature failure. Differences in footprints' contact patterns are exaggerated here. Still, underinflation certainly means excess pressure at tread's sides and overinflation means extra pressure in the center.



TOE MISALIGNMENT causes a feathered edge (top left) while grabby brakes cause spotting (top right). Uneven or excess wear (above) can come from imbalance, bad wheel bearings or shocks, or loose steering linkage.



BUILT-IN WEAR bars appear when tread is worn to the legal limit. Only $^{1}/_{16}$ in. is left.

Instead, zealous but poorly informed drivers have been known to check tires after an hour or two on the turnpike and find elevated pressure disturbing. Finding, say, a reading of 29 psi, they decide to bleed off the excess.

This misunderstanding costs tire mileage. Check them when cold. If a compressed-air source is some way off, keep the needed increase in mind, take another reading at the service station, then add the needed air—even if resulting pressure seems high.

You'll be excused if you think there's a Golden Rule of Tire Pressure, and that it says simply: More Is Better. Often enough, knowledgeable people do urge more air. But there are limits.

The extra wear caused in the center of the tread isn't the only restriction. Extreme overinflation can even be unsafe. Specific limits to cold pressure are displayed by government order. Commonly, the limit is 32 psi.

take a close look

You'll have to look closely for this Department of Transportation notice. Phrasing will be something like "MAX LOAD 1620 LBS AT 32 PSI MAX PRESS."

That DOT legend is surely important, but watch how you interpret it. There should be no more than the load specified on any tire—and then only when it's inflated to the pressure specified. There's no promise that it's safe if you exceed the limit. Granted, some enthusiasts still swear by higher readings, but they have only their instincts to go by.

Anyway, few drivers will keep tires at 32, never more nor less. So tires should be chosen with generous overcapacity.

Even if you keep the pressure right on the button, interpret load limits carefully. Many a

driver decides foolishly that if one tire can carry 1620 pounds, four can easily handle his 6000-pound car. But then he adds 1000 pounds of occupants.

And that isn't the only way to go wrong. Even without any occupants, many cars today carry about 55 per cent of their weight on the front wheels. In our hypothetical case, each front tire now carries 1650 pounds even as the car stands empty in the garage. Fronts are already overloaded.

Once you own the tires, don't think you can cock a critical eye and tell by the bulge at the bottom whether they need air. That doesn't mark a veteran judge of inflation; it marks someone uninterested in doing things right. A tire gauge is the only trustworthy answer.

get your own gauge

The gauge should be your own, too. It will mean you never need drive on tires before checking their pressure. Anyway, service station gauges aren't particularly reliable. Nearly half of those checked by the National Bureau of Standards were off by at least 3 psi. So the same tire checked at neighboring stations could easily give readings 6 psi or more apart.

Good gauges—with a likely maximum error of less than 1 psi—aren't costly. In one study a few years back, 24 such reliable gauges were found. And 21 cost less than $4. Many less than $2.

What should you look for? Nearly any will have a range of at least 10 to 40 psi, OK for car tires. Markings only 1 psi apart are handy. Gauges with the chuck at an angle to the body may be easier to use. Be sure yours has a little stud to use in letting out air when you overfill a tire. And pick one you can read in dim light.

Whether you get a popular pencil-type gauge or one with a dial, pick one that holds its reading until released. Then get a large tire dealer to let you check it against his master gauge. You'll find what correction factor, if any, to apply to your own readings.

what 'care' means

How about the business of giving tires good care? Does that mean anything beyond watching pressure?

Absolutely. But much of the care tires need is indirect, requiring car condition and driving habits such that tires aren't mistreated.

Drag starts and cowboy stops demand more of tires than is fair. They'll stand it, but you pay in lost rubber, fuel, and strain on the car. Intelligent drivers don't need such tactics.

Hard cornering is also damaging. It exaggerates the normally faster wear at the edges of front treads. Drive wheels, on the other hand, normally wear faster in the center because of the power thrust they take. Drag starts make it worse.

This difference is probably the big reason for rotating tires; it distributes special demands.

Rotation patterns vary with tire type. See the diagram on page 3056 for yours. Recommendations vary, too, on whether to include the spare. One point in favor: The spare deteriorates from age anyway. Drive on it to stretch the lives of the other four.

Snow tires need their own wheels (probably only $5 or $10 at a junk yard). It will ease putting

THE SELLING OF SOFTNESS

DETROIT HAS LONG depended heavily on one major thesis in selling its cars. It's simply this: Everybody likes to be comfortable.

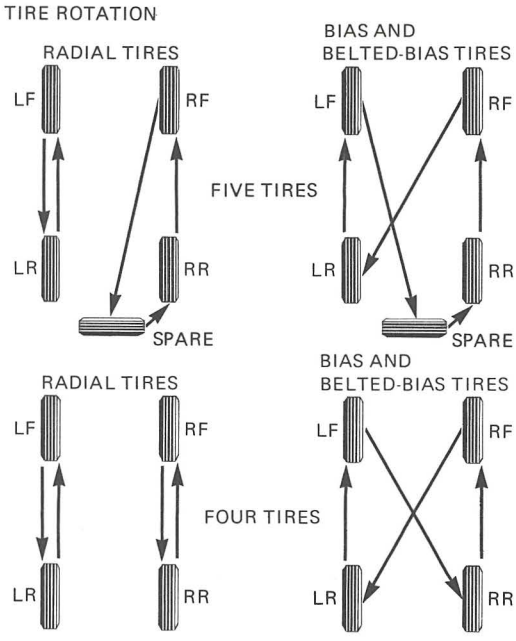
That means comfort is easy to sell. Ads about a comfortable ride appeal to more people than those that concentrate on safety or on the joys of motoring. So comfort is an aspect of nearly every car ad, every sales attempt. It dominates many of them.

And many of us equate a soft ride with comfort.

As you'd expect, Akron is reluctant to knock anything Detroit does. Detroit is, after all, Akron's biggest customer by far. Nevertheless, you'll sometimes hear a tire-design engineer grumble about Detroit's search for comfort.

More than one has muttered—in an unguarded moment—that the automobile capital wants tires to handle a job that should be given to suspension systems. That tires should grip the road, but that isolating car occupants from road bumps is the suspension's function.

This belief, that a soft ride pays off in sales (and that soft tires mean a soft ride), may be the source of car builders' recommendations for tire pressures. Careful car enthusiasts often use harder tires. And a thorough reading of the recommendations often reveals that they are actually minimums—the low limits for tire pressure.



TIRE ROTATION pattern depends on your tire type and whether the spare is part of your program.

them on the car and taking them off. It helps to keep tires and wheels balanced as integral units. And mounting and dismounting them from wheels may damage snow tires' beads.

rotation's frequency

How often to rotate tires? You can pick nearly any cycle you like and find authoritative support. Chrysler suggests every 8000 miles, at least twice a year. GM says every 6000 miles, but divisions differ about including the spare. Firestone urges rotation every 5000 miles, saying this will add 20 per cent to tire mileage. And manufacturers of some front-end-alignment gear say frequent alignment and balancing is better than any rotation.

When you do switch wheels—for whatever reason—use foresight in restoring the lug nuts. It seems so slick to spin them on by pulling the trigger on an impact wrench. But there really is little to be said for the practice. You could distort the wheel. And you may well set the nuts so tight they'll defeat efforts to remove them manually. If you ever get a flat along the road, you'll be sorry.

Daub anti-seize compound generously on lug bolts before restoring the nuts. And if you're dedicated to your impact wrench, use restraint.

Keep an eye on your tires, whether or not you rotate them. The wear pattern can tell you a lot about the condition of running gear. Pick stones carefully from tread grooves and watch for cuts or cracks. Often long ones aren't too serious, but the short ones may be deep.

That depth is what's significant. Probe it carefully with a small screwdriver. If it reaches the cord, the tire must be replaced.

Watch, too, for premature wear on one side of front-tire tread. It probably means toe-in is maladjusted. If so, an edge of one or more tread grooves is likely to be feathered, too.

Excessive wear on one side of the tread can also show too much or too little camber.

One or two badly worn spots on a tire may warn of brake trouble. If shoes grab that drum at particular spots, the grab is passed to the footprint.

A lump in the tread or sidewall says plies are separating. The tire is a candidate for a blowout—and the scrap heap.

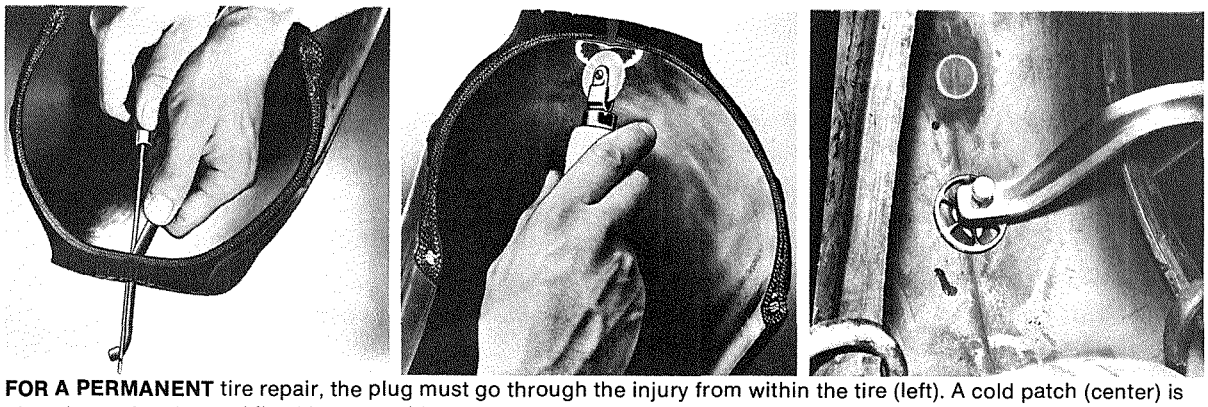
TIRE AND WHEEL assemblies should be balanced any time you have tires mounted on wheels.

NEW CARS AND DOT DATA

EVEN IN BUYING a new car, DOT tire information is important. And it's available if you ask for it. Tire Reserve Load is one example. It tells the tire's capacity beyond the car's maximum loaded weight.

If tires are inflated to carry their peak and the car has the biggest load the manufacturer says it can handle, how much extra tire capacity is available as a cushion? DOT does the figuring, to the nearest hundredth of a per cent. Calculations are carried out for each car sold in the United States and cars are ranked according to the TRL for the car's individual tire with the least reserve.

It's interesting that all the cars in the first 10 positions in a recent year were imports, with reserves from 25 to 18.06 per cent. But those in the last 20 were all U.S.-built, with reserves from 0.7 to 0 percent.



FOR A PERMANENT tire repair, the plug must go through the injury from within the tire (left). A cold patch (center) is placed over the plug and fixed in place with a stitching tool. In contrast, hot patches are clamped over the plug and heat is applied, often with a combustible substance that's part of the patch, to make the bond permanent.

Longitudinal cracks in tread grooves probably mean you alternated underinflation and overinflation.

Uneven wear can betray worn wheel bearings or indicate loose steering linkage. Or it can tell you a wheel is out of balance.

balancing the wheels

The term "wheel balancing" is misleading. The real concern is whether the entire rotating mass—tire, wheel, and brake drum—is balanced. Imbalance is serious, so rebalancing is good sense whenever a new tire goes on. Indications a wheel is out of balance (it happens easily) call for rebalancing soon.

Weights involved don't seem great, but their effect certainly is. Remember that centrifugal force increases as the *square* of rotating speed.

Take a simple example: imbalance of only an ounce at the tread of a tire 30 inches across. At 30 mph, that ounce exerts a force of about 3 pounds. At 60, it doesn't double; it quadruples—to 12 pounds. At 90, the original force isn't multiplied by 3. It's multiplied by 3 *times* 3—to 27 pounds.

The term "static imbalance" describes disproportionate weight somewhere in the plane of the wheel's rotation—maybe at the tread center. As the wheel spins, it also tries to hop up and down. Wheels can be removed from the car for static balancing; equipment isn't complex.

"Dynamic imbalance" comes from weight toward the inboard or outboard side of the wheel—often inboard in one area, outboard in another. As the wheel spins, weights pull toward the center of the rotating plane. Shimmy results.

Dynamic balancing requires more sophisticated gear, the wheel spinning at high speed. Brake drums rarely contribute much to imbalance, yet dynamic balancing while wheels are on the car has appeal.

Balanced or not, of course, tires do wear out. Decades ago, before today's highway speeds, we ran tires until they were bald. Now authorities generally agree $^1/_{16}$ inch of tread is minimal.

This still gives room for water to displace while you run at reasonable speeds in the wet. But you are approaching hydroplaning—when water can't be displaced fast enough. Then part of the footprint never touches the road.

Recognizing that danger, many states decreed tires were worn out when tread depth reached $^1/_{16}$ inch. In turn, that led to suggestions for a tread depth gauge. But you don't need it.

For about an inch of their length, grooves are now $^1/_{16}$ shallower. Shallow areas are next to each other. When tread wear exposes them, a bar appears across the tread. Bars are spaced around tires so you can see them at a glance.

breaking the code

DOT information on tires goes beyond load limits—and can be useful, especially if you scrounge around for bargains. But translation isn't easy.

The manufacturer's identification number is close to the letters DOT (on retreads, DOT-R). On new tires, the first two characters tell the manufacturer. The next two letters are a size code. And the last three digits tell when the tire was built. The final number is the last digit in the year, 7 indicating 1977, for example. The two digits before that tell the week it was built. So 087 means the eighth week in 1977.

Bargains may be easiest to find in metropolitan areas. Discounting is more common. But in small towns, a dealer's reputation is more important to him, thus more useful to you.

In any case, tire selection is more of an art than a science. You'll need all the information you can find.

How to repair a pop-up toaster

It's one of the most intricately designed small appliances in the home, but don't let that fact throw you. It also happens to be one of the most reliable devices and many of its common malfunctions are easy to repair

THE ELECTRIC POP-UP toaster is not an appliance that is easily repaired if it suffers a major parts failure. How it operates is not difficult to comprehend, but in practice the various mechanisms, levers, elements and switches make this one of the most difficult appliances in the home to salvage if a major breakdown occurs (Figure 1).

Fortunately, there are redeeming factors. First of all, the electric pop-up toaster is probably the most reliable small appliance you own. It probably will last a score of years or more, and the cost of a replacement is not great. Furthermore, if it does develop a malfunction within a relatively short period of time, the cause more often than not is a *minor* one that is easy to fix.

Keep things in perspective. Do not probe for complex answers to simple problems.

how electric pop-ups work

An electric pop-up toaster must perform several distinct functions in order to give you your morning toast. It must latch the cradle (carriage) holding bread firmly in place when the lever controlling the cradle is pushed down. It must then turn on electricity so the heating elements that do the actual toasting can begin glowing.

As with room heaters, the heating elements in a toaster are commonly made of a nickel-chromium alloy, called nichrome. Elements are connected in parallel in most toasters, so they are controlled by a common conductor.

Smaller toasters have three elements so two slices of bread may be toasted simultaneously. Larger toasters have more than three elements so that four or more slices of bread can be handled at a time.

SEE ALSO
Appliance centers . . . Electrical wiring . . . Irons . . . Kitchens . . . Mixers, food . . . Ranges . . . Trash compactors

Caution: A toaster's heating elements are not insulated. Touching one, even if the toaster is not turned on, may result in serious injury since one side of the heater circuit is always "live"—it is in constant touch with the wall outlet. When working on a toaster, make certain that it is disconnected from the wall plug except when taking voltage readings. In this case, keep the toaster disconnected until the voltmeter is connected—then plug it into the outlet, but keep your hands away from "live" elements.

Another function that an automatic toaster must perform is to shut off the current to the elements when the toast is done. At the same time it must trigger a latch that allows the cradle to surface. However, the spring-loaded cradle must have a brake on it to prevent it from snapping up too forcefully, which could cause the toast to fly halfway across the room. (Indeed that happened frequently in the very early models!)

Manufacturers have devised various methods to perform each of these functions. There is no reason to delve into each method that has been used—there are too many. A general discussion of the more common methods probably will cover your model (Figure 2).

Generally speaking, when you push down the cradle-control lever, you cause the cradle to engage a mechanical latch. (In models in which bread lowers itself automatically, a motor is used. When bread is placed in the cradle, it causes a switch to close that starts the motor which lowers the rack by means of gears.)

At the same time that the cradle is lowered, a switch is closed that activates the heater-element circuit, allowing current to flow and elements to glow.

"Light," "medium," or "dark" toast commonly is achieved by a timing mechanism that winds itself up when the cradle is pushed down. A bimetal regulator (or compensator) is used in many toasters so the first slices of toast, which are made with a cold appliance, will be toasted

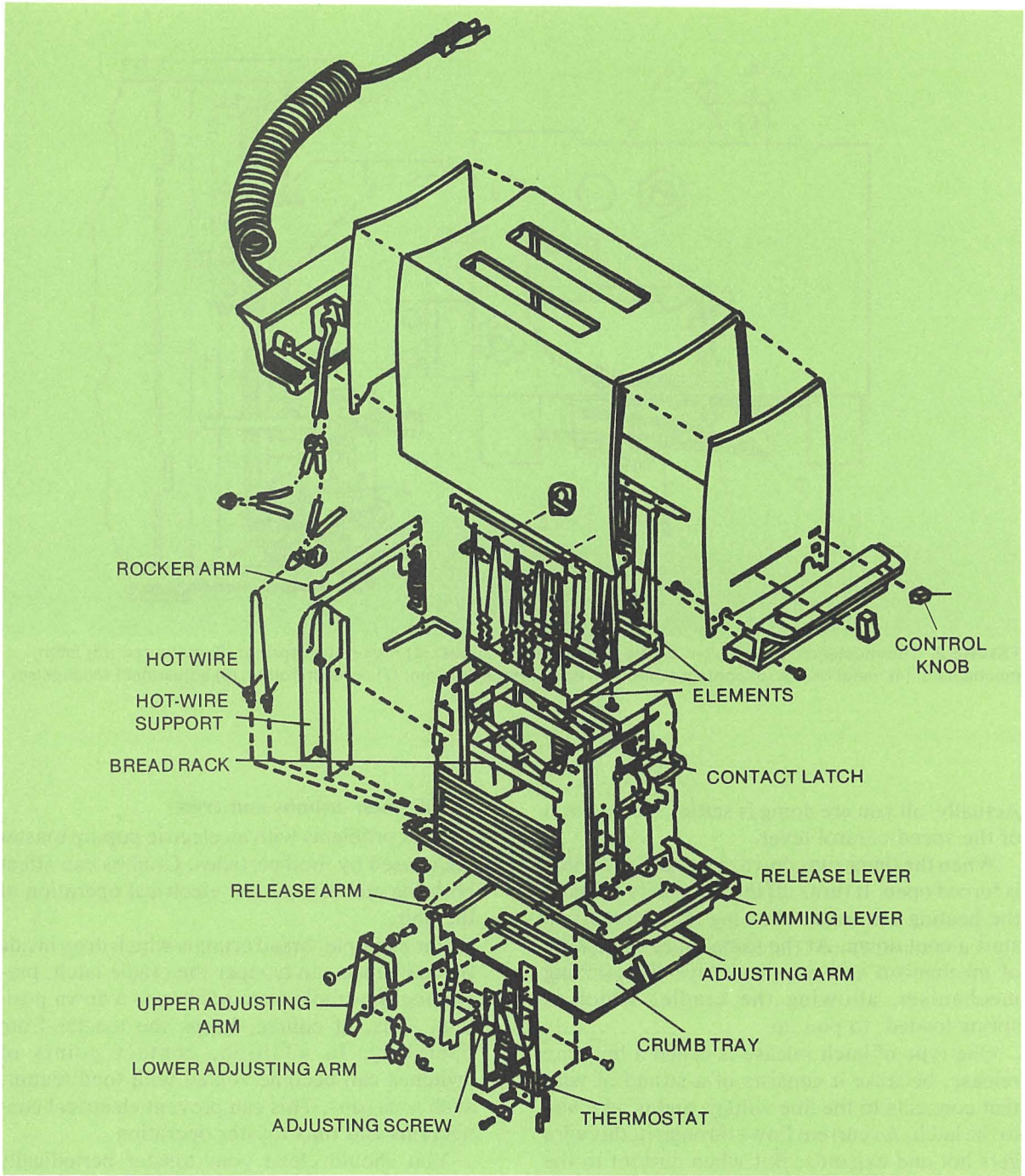


FIGURE 1. This drawing of a typical electric pop-up toaster shows what you face when you attempt to repair one. With all of its mechanisms, it is one of the most intricate small appliances.

the same as the second and subsequent slices, which are made with a hot appliance.

When the toaster is cold, the bimetal regulator is straight and does not come into contact with the timing mechanism. The mechanism is allowed to wind down for the longest period of time, giving bread more time to toast.

However, with the toaster hot and subsequent slices of bread placed in it for toasting, less time is needed. Heat affects the bimetal strip, bending it toward a speed-control lever. This lever controls the timing mechanism. When the lever is "pushed" by the bimetal strip, it causes the mechanism to speed up, which in turn results in a shorter period of operation of the timer.

The timing mechanism is set for light or dark toast, or any degree in between, by turning a knob or sliding a lever on the outside of the case.

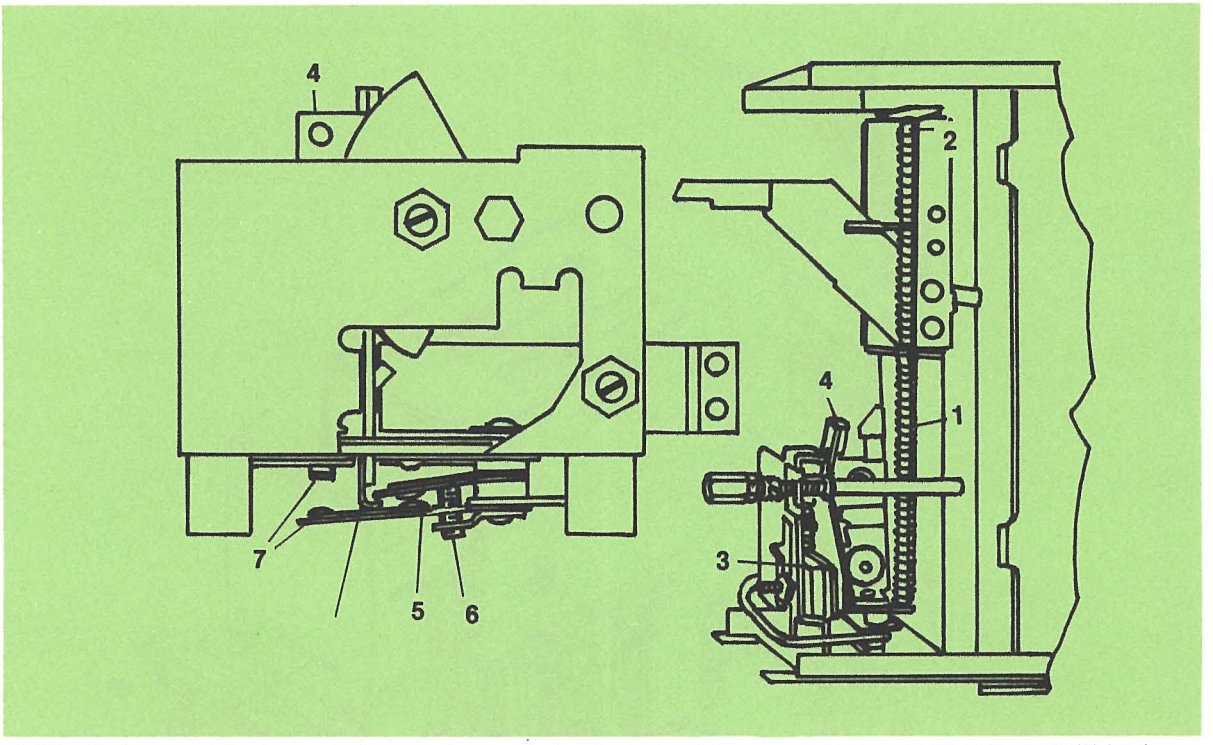


FIGURE 2. Thermostatically controlled cradle mechanism includes: (1) rack-return spring; (2) guide rod; (3) latch mechanism; (4) metal blade; (5) contact points; (6) hooking mechanism; (7) contact points; (8) adjustment mechanism.

Actually, all you are doing is setting the position of the speed-control lever.

When the timer runs down, an auxiliary switch is forced open. It turns off the electricity going to the heating elements, allowing the elements to start a cool-down. At the same time, some kind of mechanism activates and trips the latching mechanism, allowing the cradle, which is spring-loaded, to pop up.

One type of latch release is called a hot-wire release, because it consists of a strand of wire that connects to the line voltage and is attached to the latch. As current flows through it, this wire gets hot and expands. But when current to the elements is shut off, it is also shut off to the hot-wire release. The wire cools down and contracts. As it contracts, it "pulls" the latch release with it, thus releasing the cradle.

Another interesting element in an electric pop-up toaster is a shock absorber, or snubber, that cushions the cradle as it springs up. This device is similar in operation to a pneumatic stop that is employed by storm doors to keep the door from slamming. The snubber puts the brake to the cradle, allowing it to ease up so the toast doesn't fly out.

the big foes: crumbs and crud

Most problems with an electric pop-up toaster are caused by food particles. Crumbs can affect both the mechanical and electrical operation of the unit.

For example, bread crumbs which drop inside the appliance can hamper the cradle latch, preventing the cradle from holding in a down position. This, of course, keeps the toaster from operating. In addition, contact points of switches can become coated with food matter, such as raisins. This can prevent electrical connections and thus toaster operation.

You should clean your toaster periodically and thereby avoid foreign-matter problems.

Most toasters have clean-out traps that permit you to reach inside and brush out dirt (Figure 3). First *detach the power cord*. Open the trap door and brush particles from all surfaces you can reach with a one-inch paint brush that is used only for this purpose (Figure 4).

If the toaster doesn't have a trap door, disconnect the power cord and turn the appliance upside down. Shake it vigorously (Figure 5).

If the unit develops a problem and has to be disassembled, make certain that you clean the

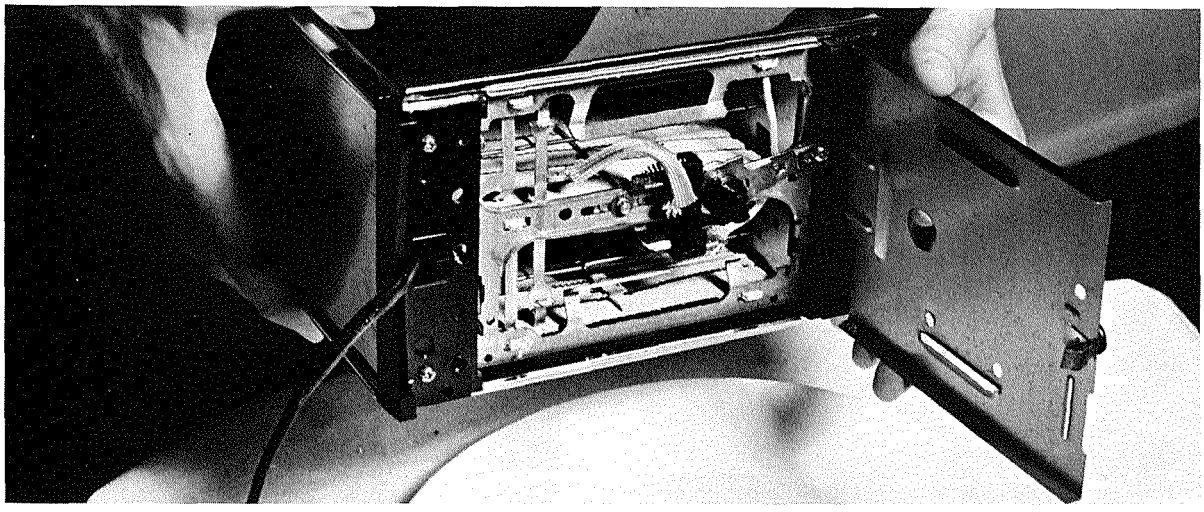


FIGURE 3. From time to time, open the trap of toaster and let loose crumbs fall out.

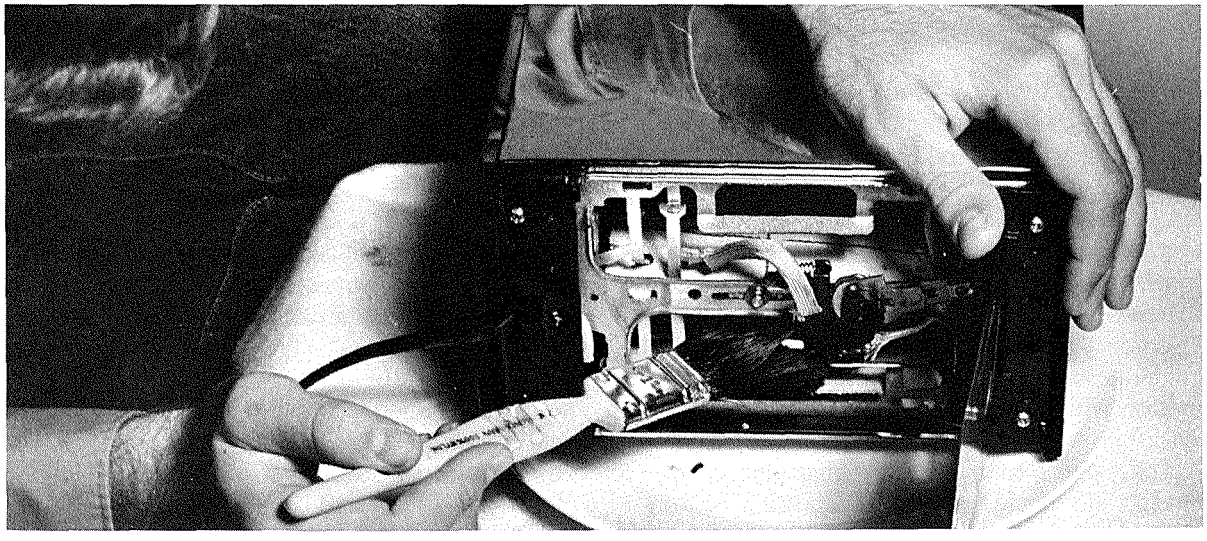


FIGURE 4. The insides of the toaster are delicate, so use a 1-inch paint brush to dislodge stubborn crumbs.

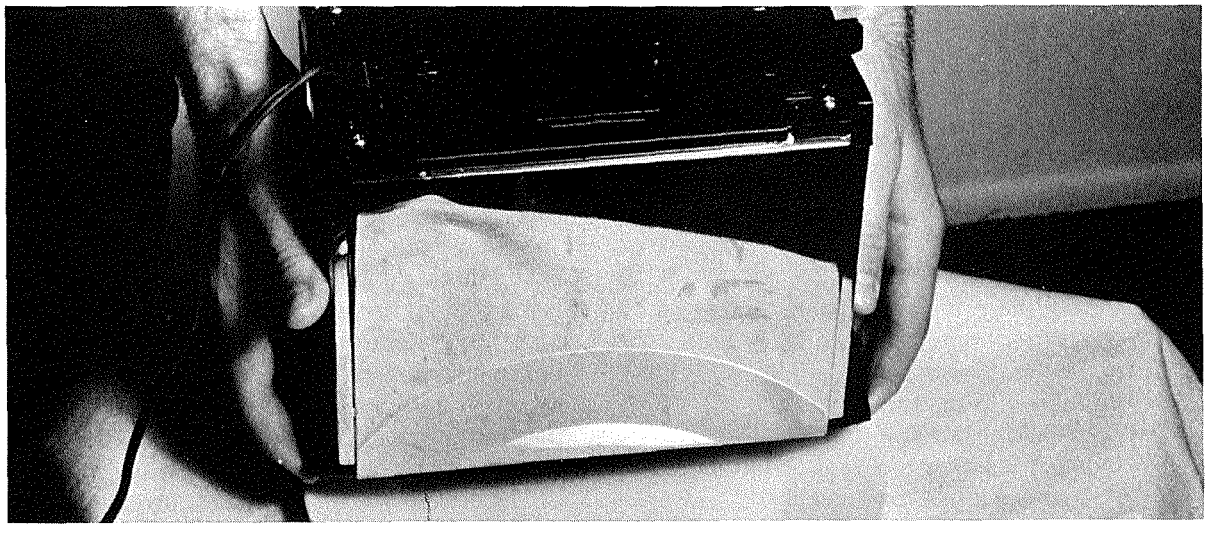


FIGURE 5. If the toaster doesn't have a clean-out trap, turn the unit upside down and shake it.

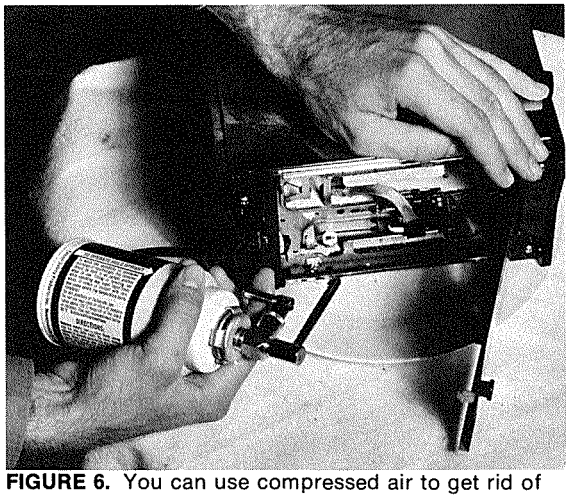


FIGURE 6. You can use compressed air to get rid of crumbs that the paint brush can't reach.

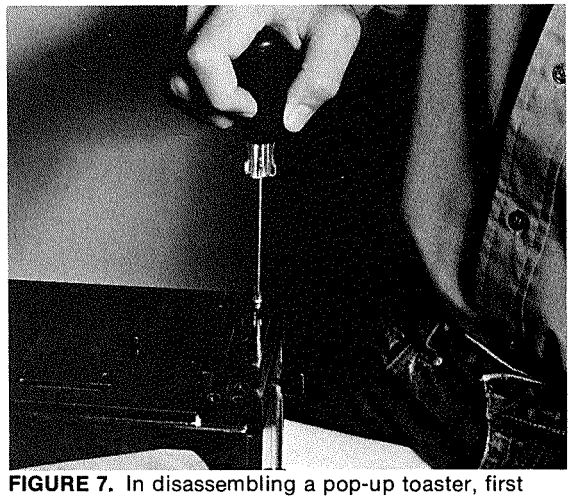


FIGURE 7. In disassembling a pop-up toaster, first remove all exposed screws.

parts as thoroughly as you can. It's still possible that crumbs, raisins, or jelly are the cause of the trouble.

The best "tool" to clean toaster parts is compressed air. You can employ it even if you don't have a compressor and air hose (Figure 6).

Visit a photography shop. Most such shops sell compressed air in a can with a nozzle. Photographers use it for cleaning dust from negatives. It is ideal for cleaning out the inside of a toaster.

When you are inside a toaster, examine all contacts and other parts carefully for burned matter which compressed air won't remove. This will have to be scraped off—carefully.

Take pains to make sure that the scraper doesn't slip accidentally and rupture a heating element.

After cleaning mechanical parts—springs, levers, catches and so forth—lubricate them lightly with a heat-resistant grease. This is available from hardware stores, but make sure that the tube stipulates that the lubricant may be used on toasters and other heat-generating appliances.

Caution: Do not apply lubricant to electrical components.

when crumbs aren't the cause

Essentially there are five problems that can afflict an electric pop-up toaster. They are:

1. The toaster doesn't work at all.
2. The toaster burns the toast.
3. The toast doesn't pop up.
4. The toast is either too light or too dark.
5. The bread doesn't toast evenly.

The easiest repairs, strangely enough, are made if the toaster doesn't work at all, assuming that all elements don't suddenly burn out at once, which isn't likely to happen. Start, of course, by examining the power cord.

Next, to check the innards, make sure that the power cord is pulled from the wall outlet. Remove the light-dark control knob, which is usually only pressed into place (Figures 7, 8, 9).

Now look for a set screw holding the cradle-control lever in place. Remove it and the lever. Unscrew all the screws you can find holding the cover and whatever ornamental trim must come off so the cover can be lifted, revealing the inside of the toaster.

The first thing to do is to give everything a very close look. See if you can spot loose connections or broken wires. Make sure the toaster end of the line cord is okay and is held tightly by its terminals.

Now check voltage, using a voltmeter on both sides of the main switch. Replace a switch if there is a lack of voltage. Other than line-cord problems, a bad switch is the chief reason a toaster will refuse to function.

Important: To check voltage, you must depress the cradle to close the switch. Don't forget to connect the power cord to a wall outlet. *Be careful!*

Suppose your problem is uneven toast, which is a common thing. Chances are that one element is burned out or a wire has come loose, disconnecting the element from its conductor. You can buy a new heating element in many cases, but before you do, check the cost of repair against the cost of a new toaster. This should be done in every instance where a repair is a major one.

The best way to discover and correct the most common causes of electric pop-up toaster problems is to use the chart.

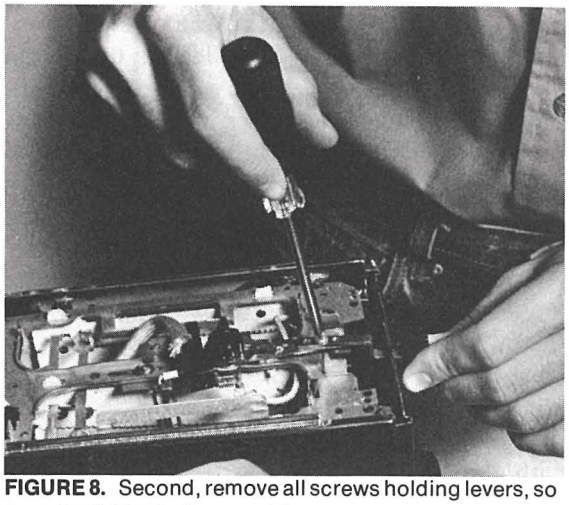


FIGURE 8. Second, remove all screws holding levers, so they don't block disassembly.

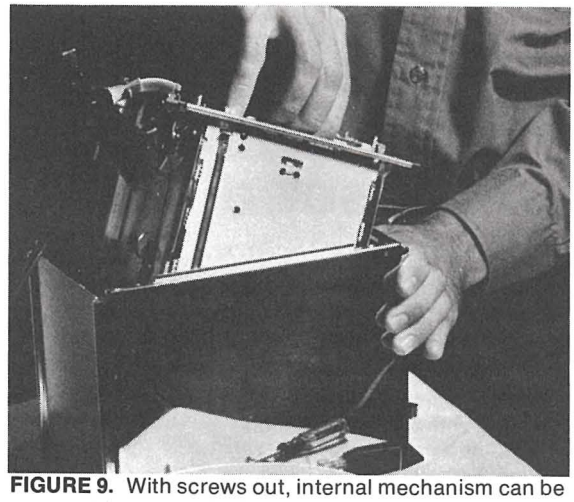


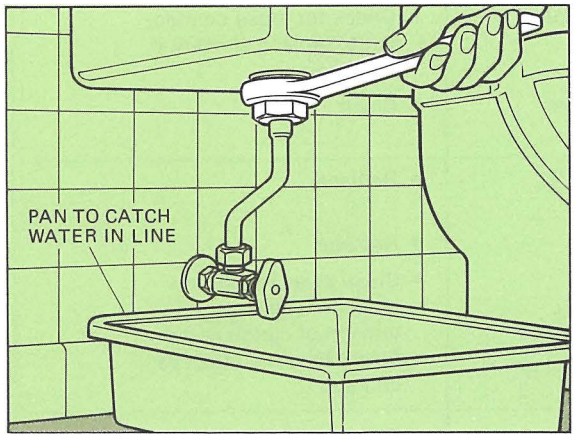
FIGURE 9. With screws out, internal mechanism can be removed from the shell.

TROUBLE	USUAL CAUSES	HOW TO CORRECT
Toast is either too dark or too light	• Timer setting incorrect	• Check position of timer control knob or lever.
	• Timer mechanism has gone awry	• Replace
Bread doesn't toast evenly	• Heating element is open	• Check for loose connections; replace element if necessary.
	• Reflective surfaces are dirty	• Clean
Toaster doesn't work at all	• Damaged power cord	• Replace
	• Open switch	• Replace
	• Impediment between latch and catch	• Clean away foreign deposits and make sure tension of clutch is sufficient to make effective contact.
Toast burns	• Improper timer setting	• Check position of timer control knob or lever.
	• Bimetal regulator is distorted	• Replace
	• Auxiliary (cool-down) switch stuck closed	• Replace
Cradle doesn't pop up	• Bread, raisins or some other foreign matter impeding catch release	• Clean thoroughly and lubricate.
	• Bimetal regulator is distorted	• Replace
	• Hot-wire or some other catch release mechanism damaged or burned out	• Replace
	• Cradle spring broken or lacks tension	• Replace

How to remove and reset a toilet

TOOLS NEEDED
Jab saw or hacksaw blade (one end covered with tape for a handle)
Putty knife or scraper
Adjustable wrench
Rags
Newspaper
Plastic pan

MATERIALS AND PARTS NEEDED
Wax seal (ring)
New hold-down bolts, nuts and washers
Toilet-bowl setting compound
Ceramic caps
Plaster of paris, ⅓-cup
New flange (optional)



Disconnecting supply line

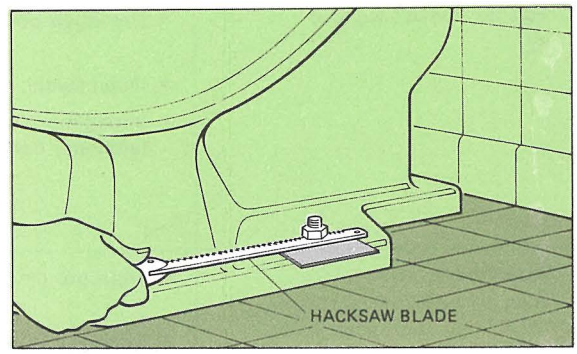
First the water supply to the toilet tank must be turned off, either at the shutoff valve below the tank or, if none, at the water supply main. With the water turned off, flush the toilet to remove as much water as possible from the bowl and tank. Next, lay newspaper on the floor to catch water that will remain in the trap of the toilet bowl. Remove the nut fastening the flexible copper supply line to the tank, being sure to position the pan below it first, as more water will flow from the opened line. Then remove the line from the wall or valve fitting, or bend it out of the way to prevent damage. Care should be exercised when bending the supply line to avoid breaking it. Remove and dump the pan.

SEE ALSO
Bathrooms . . . Bathtubs . . . Drains . . . Faucets . . . Plumbing . . . Septic systems . . . Vanities, bathroom

■ IF YOU'VE NOTICED water seeping out under your toilet bowl or collecting under and around it, chances are the wax seal between bowl and waste stack (sewer connection) needs to be replaced. Wax seals sometimes leak because they have been partially melted away by heat generated by chemicals poured into the bowl to help clear sewer lines.

There are reasons besides a faulty wax seal for having to lift a toilet: replacing wall finish behind the tank, removing an obstruction that can't be cleared with force cup or auger, or replacing a cracked bowl. Whatever the reason, each time the toilet is lifted the wax seal must be replaced with a new one.

Although replacing the seal is a job you can do in a couple of hours, you should plan it for a day when the hardware store is open; parts that haven't been disturbed for years often break when finally worked on, and you'll want the toilet back in service the same day. Cost? Usually 50 cents for the wax seal, $1 for bolts (if needed), $1 for compound, 40 cents for caps.



Loosening bowl

A toilet is most commonly fastened to a flange in the floor with two bolts. (Some older toilets may have four fasteners at the base; the two nearest the front are usually screws used as an extra hold-down.) The nuts on these bolts are covered by ceramic caps. Filled with plaster of paris, the caps are easily cracked off with the tap of a mallet or screwdriver handle. After removing the caps, clean the nuts and remove them. If bolts turn as you turn the nuts, pull up on them to lock the flats on the bolt heads into the flange slots. If the nuts will not turn at all, saw them off with the jab saw or hacksaw blade. To protect the bowl's surface from scratching, slip a piece of cardboard between the blade and the bowl when cutting.

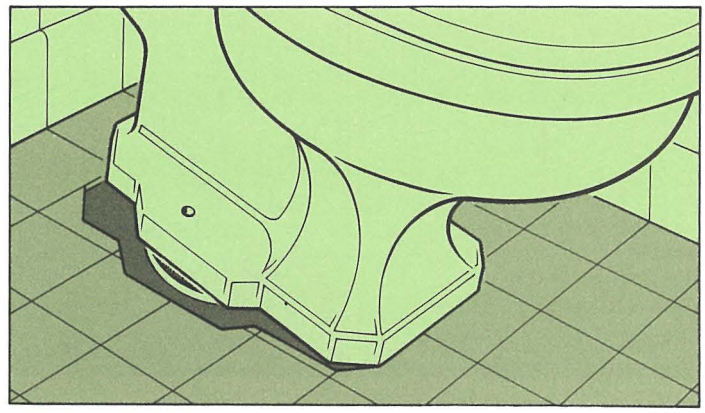
Removing bowl and seal

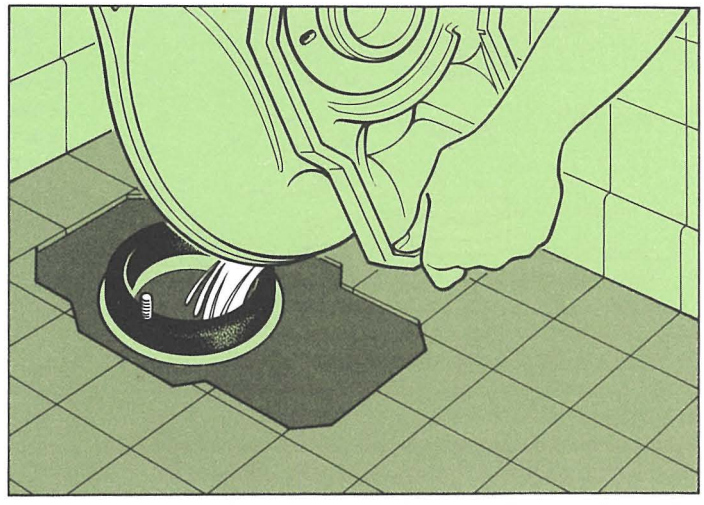
It is not necessary to open the connection between tank and bowl. Instead, after the nuts at toilet base have been removed, carefully lift both parts together, tipping them forward to drain water remaining in tank and bowl trap into the waste stack.

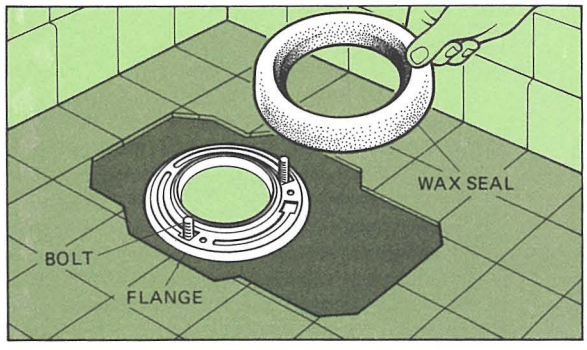
Lay the unit on its front edge carefully, on rags to protect it from possible damage. (If the undersides of bowl and tank could use a good cleaning, take the unit outdoors and use a garden hose.)

Now, remove the existing wax seal, bolts and mounting compound from the flange and scrape it clean. Thoroughly clean off the old compound from the base of the bowl. Then dry and sweep or vacuum the floor.

Caution: A wall-hung toilet must be blocked up adequately to support its considerable weight before it is unbolted from the wall. You should know that this type of toilet is much more difficult to lift and reset than the floor-mounted type. If you have any doubts about your skills, you should not attempt the job. A plumber's fee, although it may seem high, will still be less than the cost of replacing a wall-hung toilet broken by mishandling.

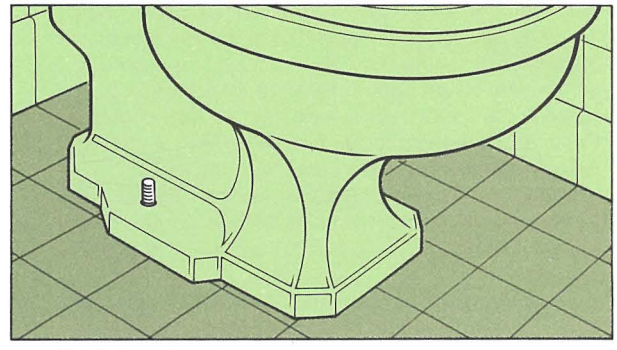






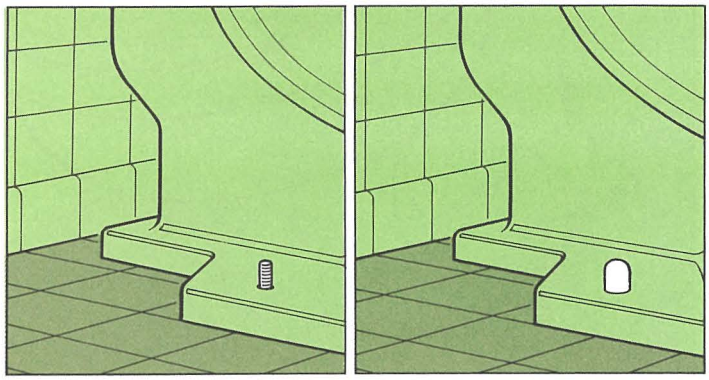
Placing the seal

Place the new wax seal on the mounting flange. (Note: the wax seal will melt at a relatively low temperature—keep it away from heat and out of direct sunlight before using.) Slip the mounting bolts into the holes in the flange, sliding them around to their approximate positions at the sides of the waste line. Apply enough setting compound to assure a solid connection to the waste stack. Then place the toilet over the flange and carefully lower it into place. If you have a helper, he can line up and steady the bolts. This makes the job considerably easier.



Retightening bowl

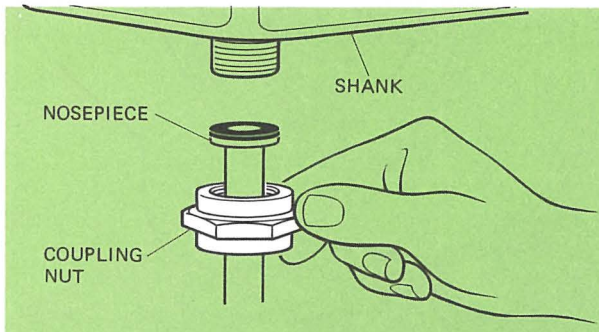
The toilet should not be resting on the wax seal with the bolts protruding through the holes in the bowl's base. Pressing downward on the sides of the bowl, rotate or wobble it until its base is resting firmly on the floor and it no longer can be rocked. The toilet is now seated and washers and nuts may be installed. Alternately tighten the nuts, making a few turns on either side; hold the bolts up to keep them from turning with the nuts. *Do not overtighten.* Overtightening the nuts could crack the base of the bowl. A toilet bowl is an expensive item to replace.



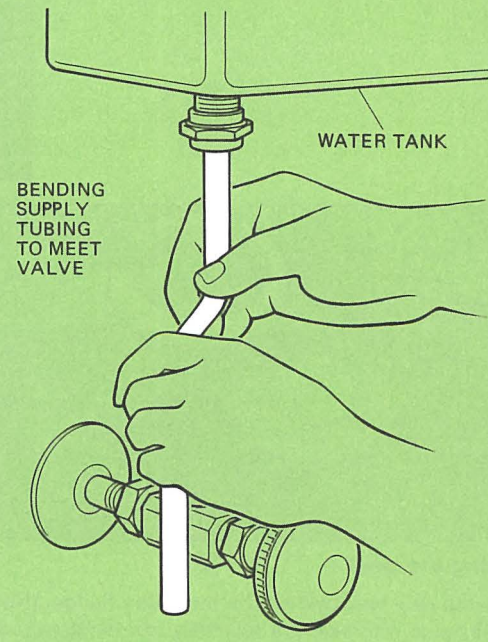
Capping bolts and nuts

Bowl at far left has been set and rests firmly on the floor. After washers and nuts are installed, they are covered for looks and protected from exposure to rust-producing moisture with ceramic caps. Test-fit the caps dry over nuts; if a bolt is too long for the cap to fit over it, saw it off at top of nut. Fill caps with plaster of paris and press into place, remove excess plaster. (Snap-on plastic caps are also available.) Then reconnect water supply line to tank.

Installing a shutoff valve in the water supply line



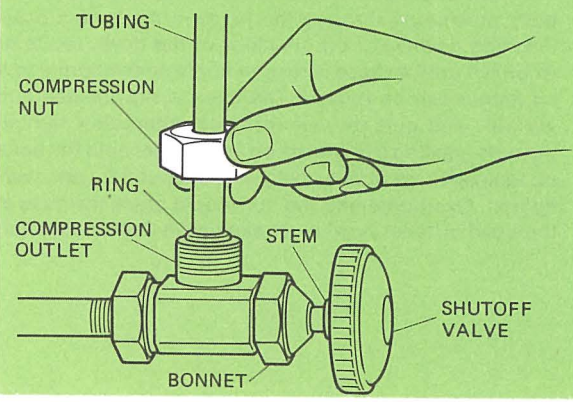
The final step in resetting a toilet is reconnecting the water supply line to the tank. But if there is no shutoff valve in the line, this is the ideal time to install one, while water is still turned off at the main. You'll find it worthwhile—especially in the event of any future trouble with the toilet or tank mechanism. Begin by reinserting the flexible supply line into the fitting on the tank and finger-tightening the coupling nut.



There should be a chrome or galvanized ½-in. nipple coming from the wall to an L (90°) fitting, with the L in turn connected to the flexible line. Remove the L fitting from the ½-in. nipple with an adjustable wrench. You may need a pipe wrench to keep the nipple from turning at the same time. The L fitting is replaced by an L valve, which should have an internal thread to receive the ½-in. nipple and, at a right angle, a threaded fitting to receive the ⅜-in. flexible tubing. Ferrule and nut normally come with the valve.

Apply pipe-joint compound to the nipple and tighten the valve onto it, making certain that the ⅜-in. fitting is in the 12:00 o'clock position when the valve is in place.

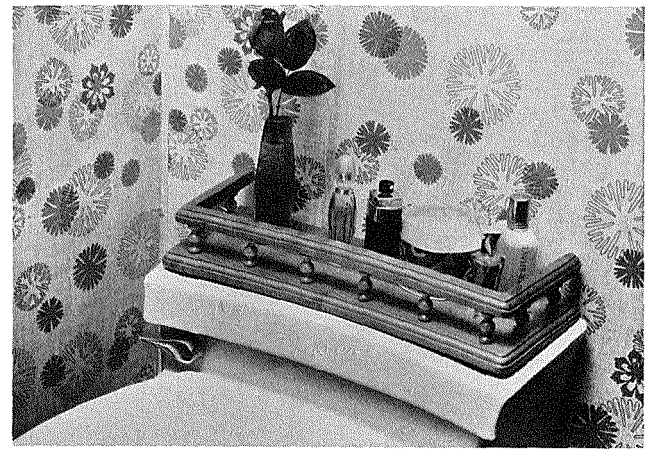
Carefully measure and bend the flexible tubing to meet the ⅜-in. opening at the top of the L valve, then cut it to length, allowing it to project into the fitting.



Slip the nut and ferrule over the cut end of the flexible tubing, push the tubing into the valve fitting and slide the ferrule and nut down. Finger-tighten the nut to make certain that the tubing is going into the fitting straight and not binding on the side of the nut. When everything is lined up, finish tightening the line at both ends. Care must be taken with both of these compression fittings to make sure the tubing goes in squarely.

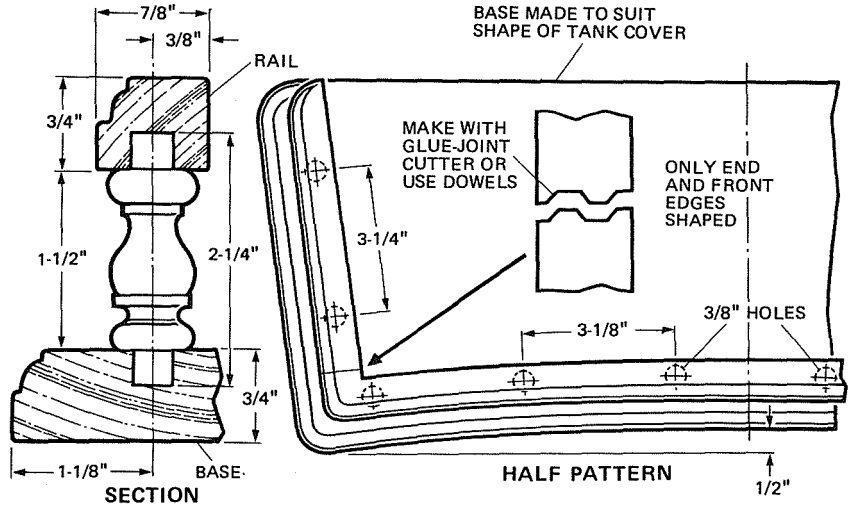
■ TOILETRIES KEPT ON TOP of the tank will stay put when corraled by this smart bathroom accessory. You make it to suit the size and shape of the tank's cover—yours may be straight; mine was curved. I cut the base from ¾-in. cherry, made the spindle railing by joining three ¾ x ⅞-in. pieces at the corners. Here I used a glue-joint cutter, but a small dowel will do. I shaped the edges with an ogee router bit.

You can turn the 10 spindles, of course, but you'll be ahead if you buy them ready-turned. They'll need sanding a bit and a quick way to do it is to chuck them in your drill press. Rubber feet will keep the shelf from rocking.



A shelf for the tank top

This gallery for your toiletries will help keep them together on top of the tank. It's a good, small woodworking project that yields a handsome product in a short time

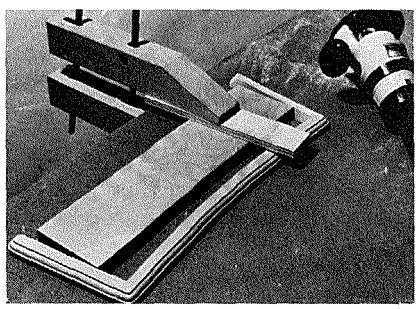


By ROSARIO CAPOTOSTO

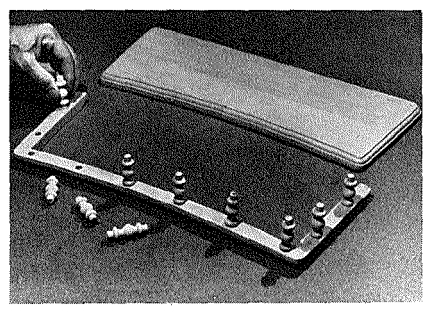
SEE ALSO

Bathrooms . . . Bathtubs . . . Shaving cabinets . . . Toilets . . . Vanities, bathroom

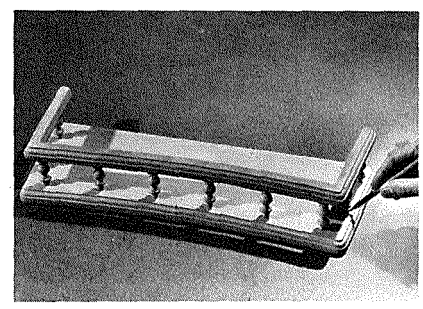
SCRAP BLOCK same thickness as rail is used to support router for shaping.



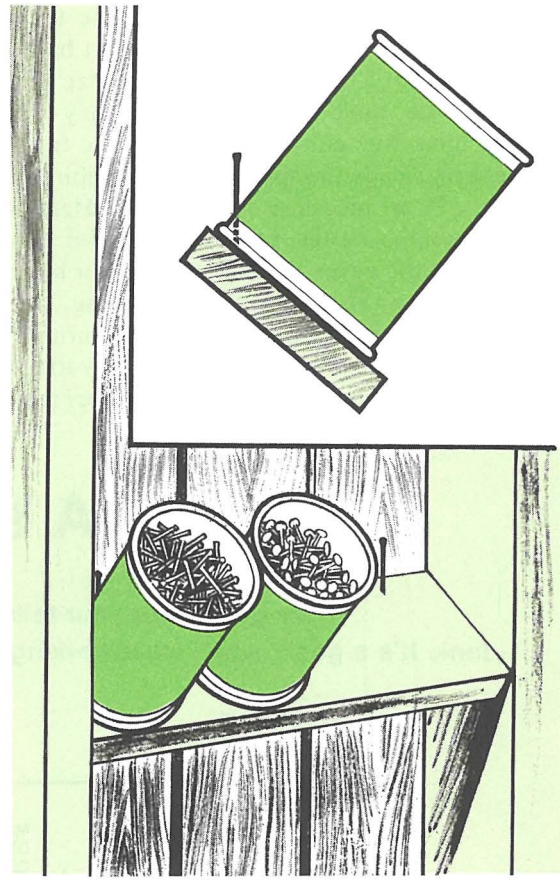
HOLES ARE used to hold spindles for applying finish; they're glued later.



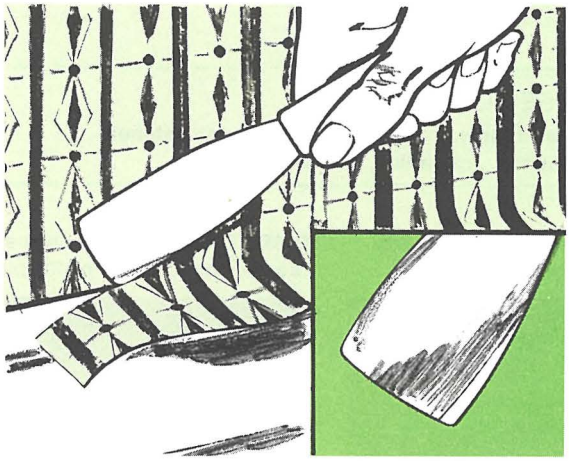
TO SPOT holes in base, use pencil to draw around tenon of each spindle.



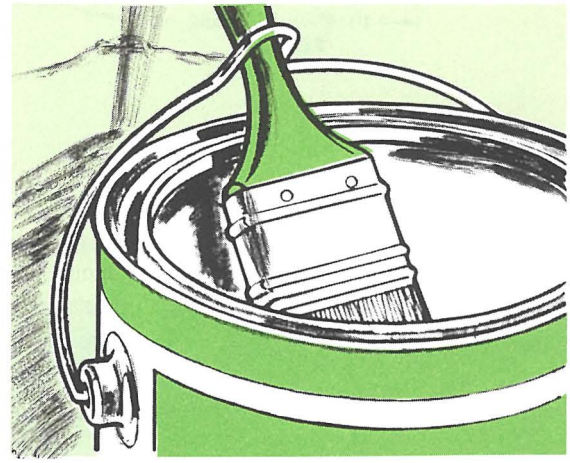
AN INSTANT BOOKCASE for your kids can be improvised from the drawers of an old shallow chest. Just remove the pulls and stack the drawers. Deep drawers can be made shallow by installing a stop.



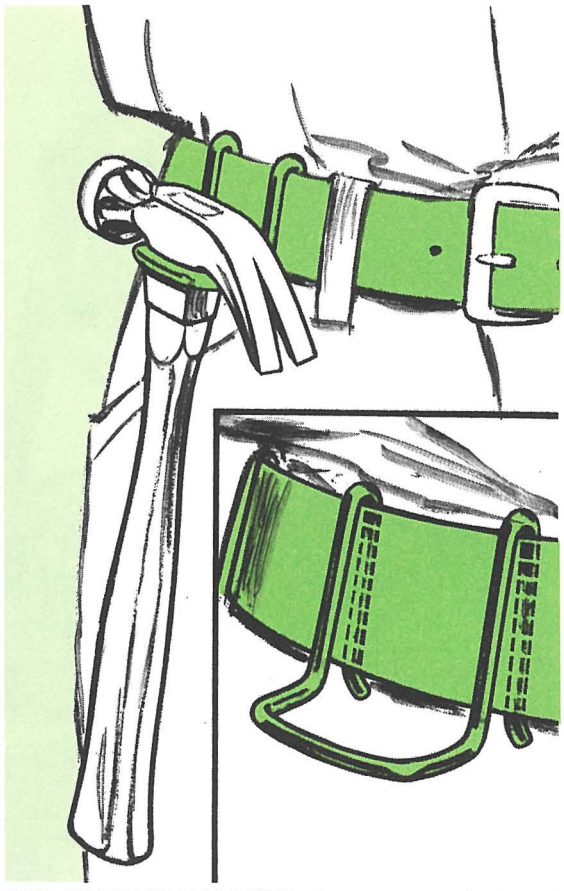
HANDY BINS for storing nails, screws, washers and other small objects in your shop are just angle-hung coffee cans. Punch a hole through the side and bottom, as shown; mount on a board between studs.



SHARPENING THE CORNER and a portion of one edge of the putty knife you use when you are applying wallpaper will give you a handy tool for trimming paper at the baseboard.



BEFORE YOU START to paint, bend a loop in the wire bail of the can to form a spring fit around the narrowest portion of the paintbrush handle. It makes a neat and dripless holder for your paintbrush.



THIS HAMMER HOLSTER slips over your belt and holds your hammer when you need your hands free for something else. Make it by bending a length of heavy coat-hanger wire. Round off ends with a file.

IF YOU'RE A NOVICE with an ax, one of the safest methods of splitting wood is to prop the log upright inside a couple of old tires. If you should miss the log, the tires will absorb the shock without moving.

TO PLANT FINE SEEDS easily and efficiently, use an eye dropper as a seed dispenser. It allows for much better seed spacing than sowing by hand. For smaller seeds plug part of the opening with a toothpick.

TO SOFTEN THE TIP of a felt-tipped marking pen which has hardened after being left uncapped, place a few drops of spot remover in a dish and work the tip around in it. When its soft, wipe the tip.

Fold-up toter for hobby projects

By SHELDON M. GALLAGER

IF YOU ENJOY kit-building and model-making but don't have a permanent place for such activities, here's a portable work center you can set up and put away quickly as needed. The tool-and-parts caddy can be placed on a desk, dining table or other surface for temporary use, then folded up for easy storage in a closet. Small parts are kept neatly sorted in lift-out muffin tins that can be switched to suit whatever project you're working on. One tin might hold parts for a hi-fi kit, another those for a model plane or car.

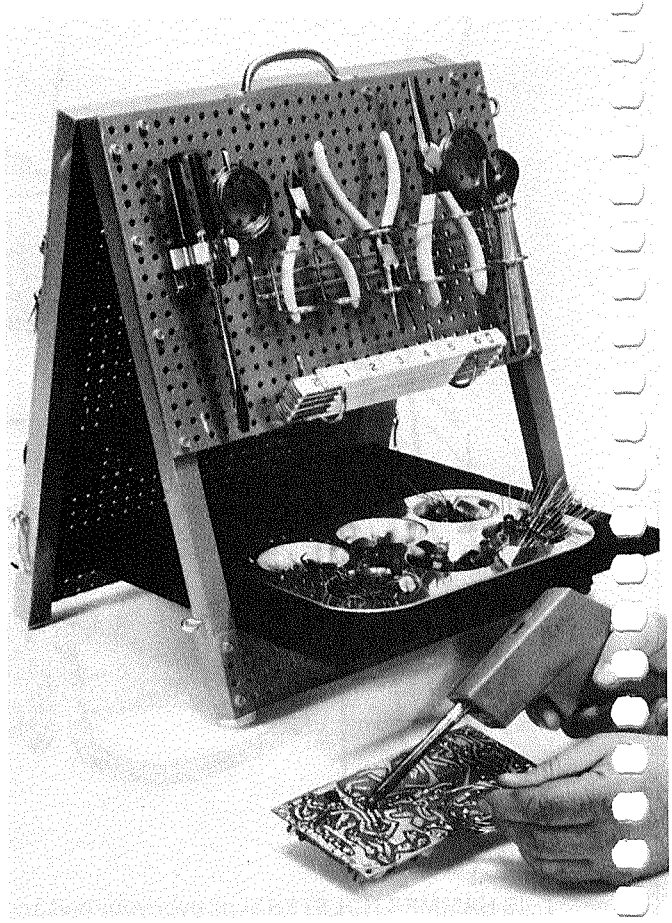
The toter consists of two hinged panels that open out to form a sturdy A-frame stand. The panels are made of perforated hardboard (Pegboard) screwed to ¾-inch-square framing strips. Using standard Pegboard fixtures, you can arrange the panels to hold any assortment of tools you like. Put the most frequently used items on the front where they're readily accessible. The back panel can store special tools and extra supplies.

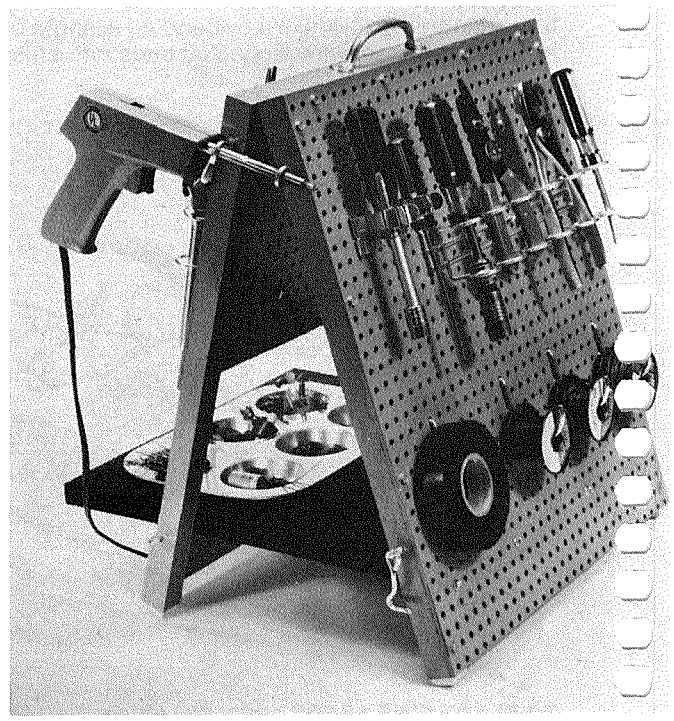
You can, of course, make the carrier any size you wish. The dimensions shown here are based on a six-compartment muffin tin that typically measures about 7 by 10 inches. The tin is held in a plywood shelf that protrudes through an opening in the front panel and is hinged to a cleat screwed to the back panel. To collapse the carrier, you simply remove the parts tray, swing the shelf up between the two panels, then fold the panels flat together. Rubber stick-on feet keep the panels from slipping when opened, and screen-door hooks hold them together when closed.

Note that the cleat supporting the rear edge of the hinged shelf is 1 inch wide, projecting slightly beyond the ¾-inch thickness of the back-panel framing. This provides necessary clearance for the shelf to swing up between the panels without striking the fixture hooks that stick through on the inside of the back panel. It also allows space for two or three empty muffin tins to be left stacked in the shelf in the closed position.

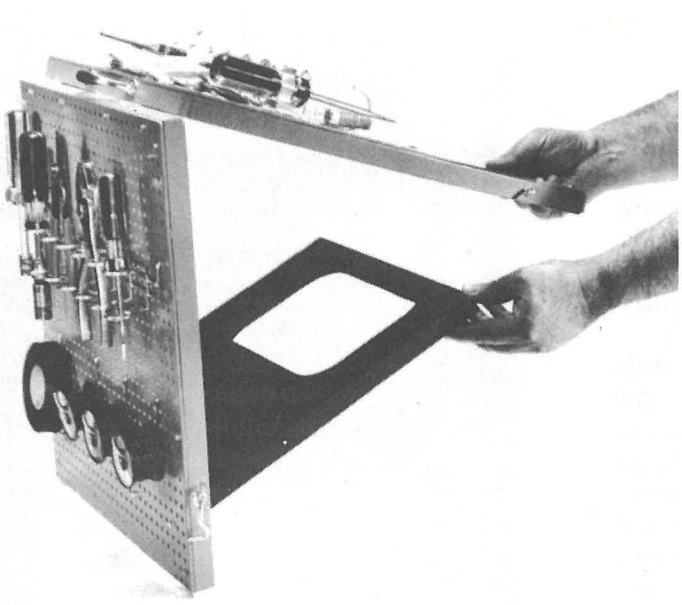
SEE ALSO

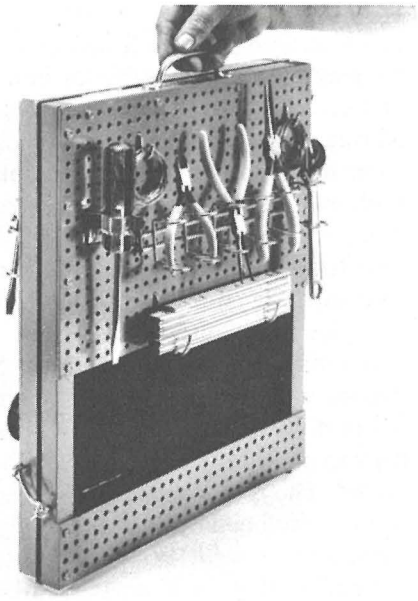
Electronics . . . Modelmaking . . . Storage ideas . . . Toolboxes . . . Tools, hand . . . Workbenches



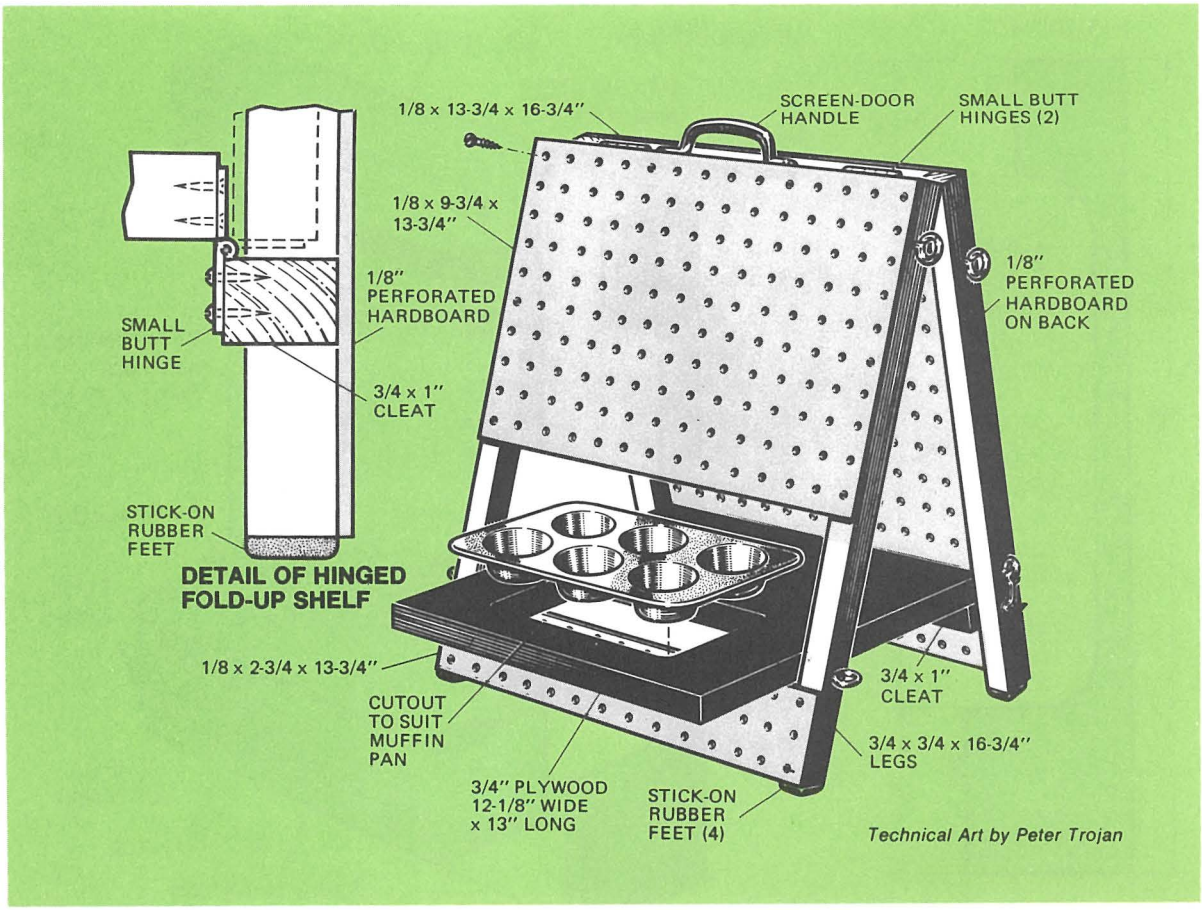


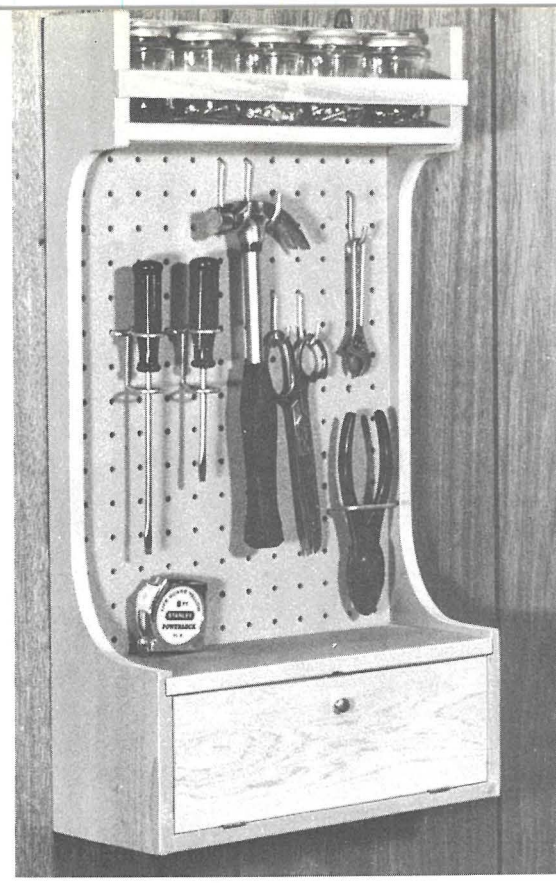
SIMPLE HOLDER for a hot soldering gun or pencil iron can be made from two screw eyes, one in each panel edge. Locate the eyes so they hold tool at slight downward-tipped angle to keep it from sliding out.





COLLAPSING THE CADDY for storage is simple. You just slip parts shelf out of opening in front panel (left, above) and swing it upward between framing strips in rear panel. Two panels then fold flat together and hook (right). A rule held in U-shaped hooks across front is handy for measuring wire lengths in electronic kit-building; you can hold the wire up to it without even removing the rule from the side of the board.

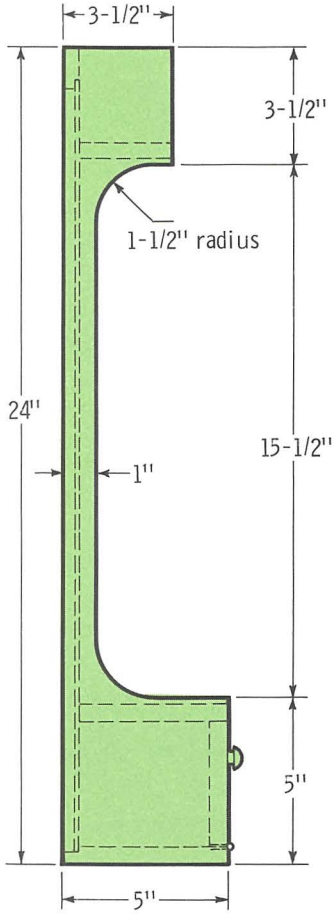

1/8 x 13-3/4 x 16-3/4"
SCREEN-DOOR HANDLE
SMALL BUTT HINGES (2)
1/8 x 9-3/4 x 13-3/4"
1/8" PERFORATED HARDBOARD
1/8" PERFORATED HARDBOARD ON BACK
SMALL BUTT HINGE
3/4 x 1" CLEAT
STICK-ON RUBBER FEET
DETAIL OF HINGED FOLD-UP SHELF
1/8 x 2-3/4 x 13-3/4"
CUTOUT TO SUIT MUFFIN PAN
3/4" PLYWOOD 12-1/8" WIDE x 13" LONG
STICK-ON RUBBER FEET (4)
3/4 x 1" CLEAT
3/4 x 3/4 x 16-3/4" LEGS
Technical Art by Peter Trojan

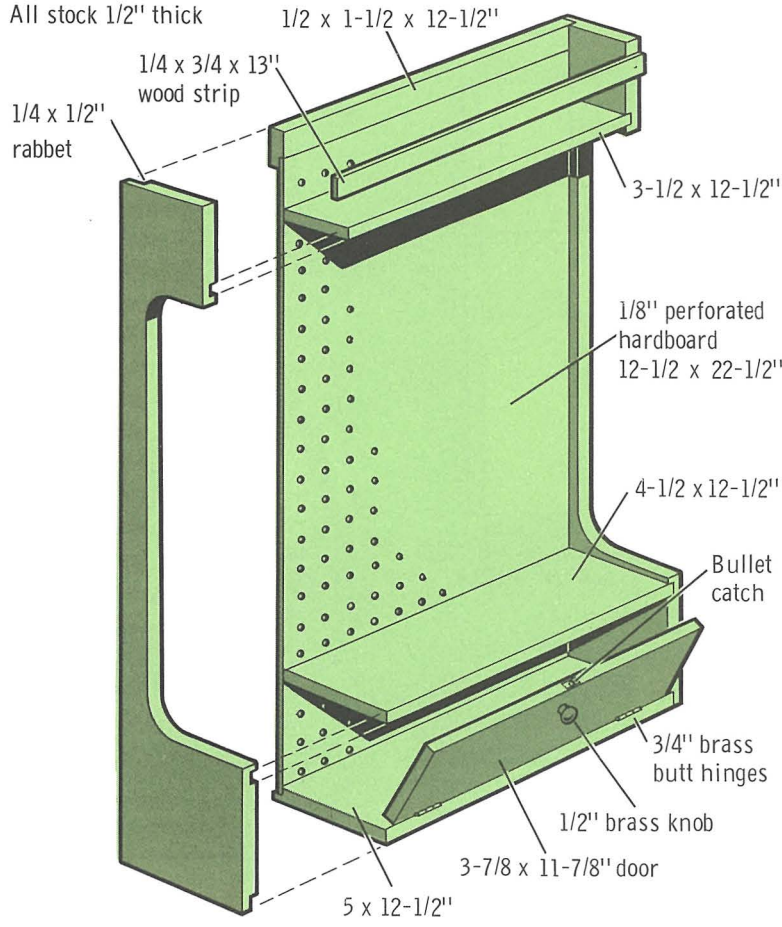


IF YOUR WIFE enjoys working with tools as much as you do, she'll appreciate having this hanging tool bar close by for minor repair jobs and quick projects. Household jobs such as repairing small appliances, retacking a sagging chair bottom, and changing the plug on a lamp probably will be done when they're first discovered, with the proper tools readily available. This toolbox is stocked with a hammer, pliers, steel tape, an adjustable wrench and screwdrivers, plus nails, screws and tacks.

It's simple to make as shown. Shelves fit in dadoes and rabbets cut in matching sides, and the perforated tool panel sets in ½ in. from the back to provide clearance for standard pegboard hooks. The toolbox pictured at right was made from ½-inch cedar, but ½-inch plywood would work just as well. When laying out the sides, remember that they must be made right and left-hand insofar as dadoes and rabbets are concerned. When sawing them out, it's smart to tack both pieces back to back and saw at one time. The completed rack can be hung on a wall or back of a door with L-hooks and screw eyes.

A toolbox for your wife




All stock 1/2" thick
1/2 x 1-1/2 x 12-1/2"
1/4 x 3/4 x 13" wood strip
1/4 x 1/2" rabbet
3-1/2 x 12-1/2"
1/8" perforated hardboard 12-1/2 x 22-1/2"
4-1/2 x 12-1/2"
Bullet catch
3/4" brass butt hinges
1/2" brass knob
3-7/8 x 11-7/8" door
5 x 12-1/2"

METRIC CONVERSION

Conversion factors can be carried so far they become impractical. In cases below where an entry is exact it is followed by an asterisk (*). Where considerable rounding off has taken place, the entry is followed by a + or a − sign.

CUSTOMARY TO METRIC

Linear Measure

inches	millimeters
1/16	1.5875*
1/8	3.2
3/16	4.8
1/4	6.35*
5/16	7.9
3/8	9.5
7/16	11.1
1/2	12.7*
9/16	14.3
5/8	15.9
11/16	17.5
3/4	19.05*
13/16	20.6
7/8	22.2
15/16	23.8
1	25.4*

inches	centimeters
1	2.54*
2	5.1
3	7.6
4	10.2
5	12.7*
6	15.2
7	17.8
8	20.3
9	22.9
10	25.4*
11	27.9
12	30.5

feet	centimeters	meters
1	30.48*	.3048*
2	61	.61
3	91	.91
4	122	1.22
5	152	1.52
6	183	1.83
7	213	2.13
8	244	2.44
9	274	2.74
10	305	3.05
50	1524*	15.24*
100	3048*	30.48*

1 yard = .9144* meters
1 rod = 5.0292* meters
1 mile = 1.6 kilometers
1 nautical mile = 1.852* kilometers

Fluid Measure

(Milliliters [ml] and cubic centimeters [cc or cu cm] are equivalent, but it is customary to use milliliters for liquids.)

1 cu in = 16.39 ml
1 fl oz = 29.6 ml
1 cup = 237 ml
1 pint = 473 ml
1 quart = 946 ml
= .946 liters
1 gallon = 3785 ml
= 3.785 liters
Formula (exact):
fluid ounces × 29.573 529 562 5* = milliliters

Weights

ounces	grams
1	28.3
2	56.7
3	85
4	113
5	142
6	170
7	198
8	227
9	255
10	283
11	312
12	340
13	369
14	397
15	425
16	454

Formula (exact):
ounces × 28.349 523 125* = grams

pounds	kilograms
1	.45
2	.9
3	1.4
4	1.8
5	2.3
6	2.7
7	3.2
8	3.6
9	4.1
10	4.5

1 short ton (2000 lbs) = 907 kilograms (kg)
Formula (exact):
pounds × .453 592 37* = kilograms

Volume

1 cu in = 16.39 cubic centimeters (cc)
1 cu ft = 28 316.7 cc
1 bushel = 35 239.1 cc
1 peck = 8 809.8 cc

Area

1 sq in = 6.45 sq cm
1 sq ft = 929 sq cm
= .093 sq meters
1 sq yd = .84 sq meters
1 acre = 4 046.9 sq meters
= .404 7 hectares
1 sq mile = 2 589 988 sq meters
= 259 hectares
= 2.589 9 sq kilometers

Kitchen Measure

1 teaspoon = 4.93 milliliters (ml)
1 Tablespoon = 14.79 milliliters (ml)

Miscellaneous

1 British thermal unit (Btu) (mean) = 1 055.9 joules
1 calorie (mean) = 4.19 joules
1 horsepower = 745.7 watts
= .75 kilowatts
caliber (diameter of a firearm's bore in hundredths of an inch) = .254 millimeters (mm)
1 atmosphere pressure = 101 325* pascals (newtons per sq meter)
1 pound per square inch (psi) = 6 895 pascals
1 pound per square foot = 47.9 pascals
1 knot = 1.85 kilometers per hour
25 miles per hour = 40.2 kilometers per hour
50 miles per hour = 80.5 kilometers per hour
75 miles per hour = 120.7 kilometers per hour

METRIC TO CUSTOMARY

Linear Measure

millimeters (mm)	fractions of an inch (to nearest 1/64")
1	3/64-
2	5/64 +
3	7/64-
4	11/64-
5	13/64-
6	15/64 +
7	17/64 +
8	5/16 +
9	23/64-
10	25/64 +

Formula:
millimeters × .039 37 = inches

centimeters (cm)	inches (to nearest 1/64")
1	25/64 +
2	25/32 +
3	1 3/16-
4	1 37/64-
5	1 37/32-
6	2 23/64 +
7	2 3/4 +
8	3 5/32-
9	3 35/64-
10	3 15/16-

Formula:
centimeters × .393 7 = inches

meters	feet (to nearest 1/4 inch)
1	3' 3 1/4 + "
2	6' 6 3/4-"
3	9' 10 + "
4	13' 1 1/2 + "
5	16' 4 3/4 + "
6	19' 8 1/4-"
7	22' 11 1/2 + "
8	26' 3-"
9	29' 6 1/4 + "
10	32' 9 1/2 + "

Formula:
meters × 3.280 8 = feet
1 kilometer = 3280.839 8 feet
= .621 371 miles

Fluid Measure

1 milliliter (ml)	= .034- oz (fluid ounces)
10 ml	= .34- oz
100 ml	= 3.4- oz
1 liter	= 33.8 + oz
	= 2 pints, 2- oz
	= 1 quart, 2- oz

Formulas:
liters × 33.814 056 = ounces (fluid)
milliliters × .033 814 056 = ounces (fluid)

Weight

grams	ounces (avoirdupois)
1	.035 +
10	.353-
50	1.76 +
100	3.52-
500	1 lb 1.7- oz
1000	2 lb 3.3- oz

Formula:
grams × .035 273 99 = ounces (avoirdupois)

kilograms	pounds (to the nearest ounce)
1	2 lb 3 + oz
2	4 lb 7- oz
3	6 lb 9 + oz
4	8 lb 13 + oz
5	11 + lb
6	13 lb 4- oz
7	15 lb 7- oz
8	17 lb 10 + oz
9	19 lb 13- oz
10	22 lb 1- oz

Formula:
kilograms × 2.204 622 4 = pounds
1 metric ton (1000 kg) = 2 204.6 pounds

Volume

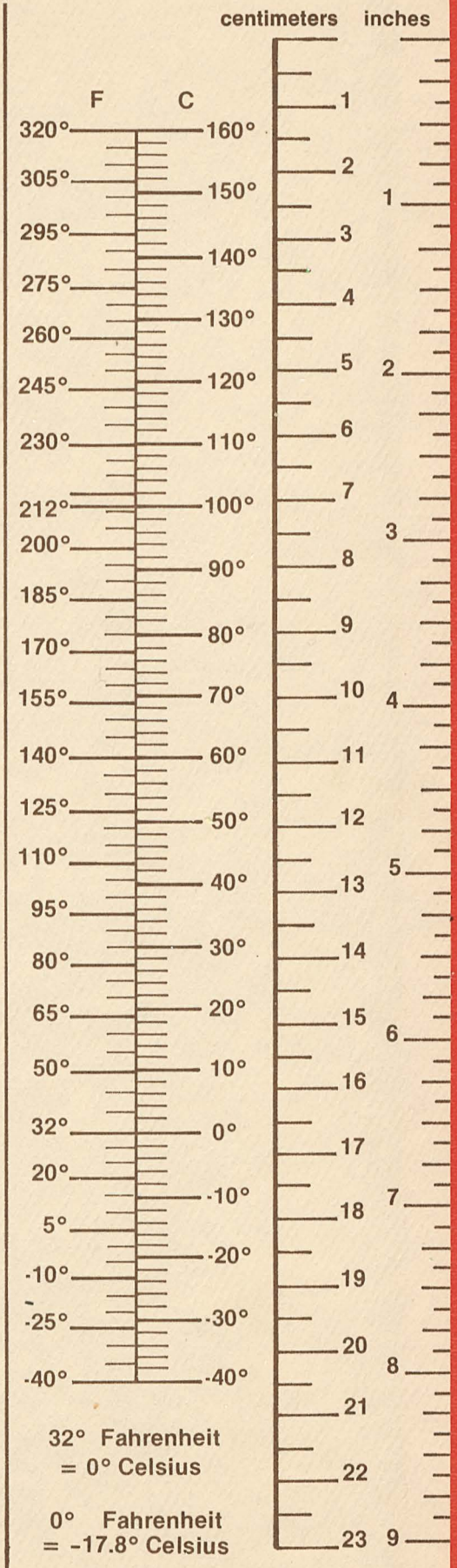
1 cubic centimeter (= 1 milliliter) = .061 + cubic inches
1 liter (1000 cc) = 61 + cubic inches
1 cubic meter = 35.3 + cubic feet

Area

1 square centimeter = .155 square inches
1 square decimeter = 15.5 square inches
1 square meter = 9.29 square feet = .84- square yards
1 hectare (10 000 sq. meters) = 2.47 + acres

Miscellaneous

1 newton (N) = 4.45- pounds of force
1 pascal (Pa) (pressure) = .000 145 + psi = .021- pounds per sq ft
1 kilopascal (kPa) = .145 + psi = 21- pounds per sq ft
25 kilometers per hour (km/h) = 15.5 + mph
50 km/h = 31.1- mph
75 km/h = 46.6 + mph
100 km/h = 62.1 + mph
Formula:
km/h × .621 371 = miles per hour



32° Fahrenheit = 0° Celsius

0° Fahrenheit = -17.8° Celsius